FUNCTIONAL AND RADIOLOGICAL OUTCOME OF SURGICAL MANAGEMENT OF ACETABULAR FRACTURES

Dissertation submitted in
Partial fulfilment of the regulations required for the award of

M.S. DEGREE in
ORTHOPAEDIC SURGERY

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

COIMBATORE-TAMILNADU

APRIL 2019

Coimbatore Medical College

COIMBATORE, TAMILNADU, INDIA - 641 014

(Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai)

ETHICS COMMITTEE

CERTIFICATE

Name of the Candidate:		**Dr. SharonAchar .T**
Course	:	**MS (Orthopedics) Post Graduate**
Period of Study	:	**1 year**
College	:	**Coimbatore Medical College & Hospital.**
Dissertation Topic	:	**Functional and radiological outcome of surgical management of acetabular fractures**

The Ethics Committee, Coimbatore Medical College has decided to inform that your Dissertation Proposal is accepted and you are permitted to proceed with the above Study.

24.12.16

Member Secretary
Ethics Committee

CERTIFICATE

This is to certify that this dissertation titled **"Functional and radiological outcome of surgical management of acetabular fractures"** is a bonafide record of work done by **Dr.Sharan Achar T,** during the period of his post graduate study from May 2016 to September 2018 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Coimbatore Medical College and Hospital, Coimbtore-641018, in partial fulfilment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2019.

Dr. B.ASOKAN, M.S, Mch
Dean
Coimbatore Medical College & Hospital
Coimbatore- 641018

Prof.Dr.S.VETRIVEL CHEZIAN,
M.S Ortho, D.Ortho, FRCS, PhD
Professor & Head of Department
Institute of Orthopaedics and traumatology
Coimbatore Medical College &Hospital

DECLARATION

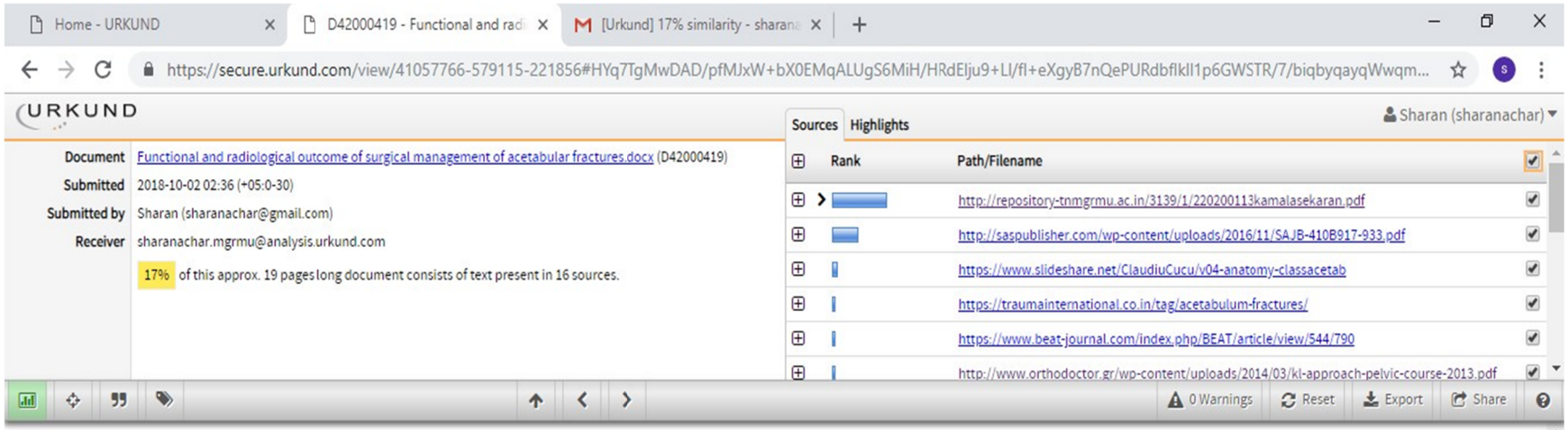
I declare that the dissertation entitled ***"FUNCTIONAL AND RADIOLOGICAL OUTCOME OF SURGICAL MANAGEMENT OF ACETABULAR FRACTURES"*** *submitted by me for the degree of M.S Orthopaedic Surgery is the record work carried out by me during the period of* ***May 2016 to September 2018*** *under the guidance of* ***Prof Dr S.Vetrivel Chezian, M.S.Ortho, D.Ortho, FRCS, PhD,*** *Head of the Department, Institute of Orthopaedics and Traumatology, Coimbatore Medical College & Hospital, Coimbatore. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Coimbatore, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS examination to be held in April 2019.*

Signature of the Candidate

(Dr.Sharan Achar T)

Date:
Place: Coimbatore

Signature of the Guide
Prof.Dr.S.Vetrivel Chezian, M.S.Ortho.,D.Ortho., FRCS, PhD,
Professor & Head of Department
Institute of Orthopaedics and Traumatology,
Coimbatore Medical College, Coimbatore.



INTRODUCTION

Fractures of acetabulum are relatively uncommon, but as they involve the major weight bearing joint in lower extremity, they assume great clinical importance. Fractures of acetabulum occur primarily in young adults due to high-velocity trauma and in old age even with trivial trauma. Over the last 25 years, improvements in vehicle

47% #1 Active

care, resuscitation and transport with standardized treatment protocols have all resulted in improved survival following severe pelvic trauma. Only 10% of the pelvic injuries involve

External source: http://repository-tnmgrmu.ac.in/3139/1/220200113kamalasekaran.pdf 47%

care, resuscitation, and transport as well as standardized protocols for treatment have all contributed to improved survival after severe pelvic injuries. Only 10% of the pelvic disruptions involve

the acetabulum. The displaced acetabular fracture fragments result in hip joint incongruity which in turn lead to abnormal presure distribution over the articular cartilage surface. This may lead to accelerated breakdown of the articular cartilage, resulting in disabling irreversible arthritis of hip joint. Acetabular fractures are usually associated with injuries of other parts of the pelvis and lower limbs which influences the

treatment options, surgical approaches, clinical and radiological outcomes. Patient age, fracture stability, presence of comorbidities and osteoporosis, along with

the surgeon's experience, all influence the treatment options. For decades non-operative treatment of acetabular fractures had been practiced as not many surgeons comprehended the normal and pathological anatomy of acetabulum together with concept of surgical approaches for the pelvis. Judet et al 2 in 1960s established the operative treatment of these fractures by continuous improvement of pre-operative evaluation and classification of fractures. The aim of treatment of these difficult acetabular fractures is concentric

ACKNOWLEDGEMENT

I express my thanks and gratitude to our respected Dean **Prof.Dr. B.Asokan, M.S, Mch,** Coimbatore Medical College & Hospital, for having given permission for conducting this study and utilize the clinical materials of this hospital.

I have great pleasure in thanking **Prof.Dr. S.Vetrivel Chezian, M.S.Ortho., D.Ortho, FRCS., PhD,** Director, Institute of Orthopaedics and Traumatology, for his guidance and constant advice provided throughout this study.

I sincerely thank **Prof.Dr.D.R.Ramprasath, M.S.Ortho**., for his advice, guidance and unrelenting support during the study.

My sincere thanks and gratitude to **Prof.Dr.T.Karikalan, M.S.Ortho,** for his constant advice and guidance.

My sincere thanks to **Prof.Dr.P.Kosalaraman,** former Associate Professor, Department Of Orthopaedicsfor their constant inspiration, guidance and advice.

I sincerely thank **Dr.Marimuthu, Dr.M.S.Mugundhan, Dr.K.S.Maheswaran**, **Dr.Balamurugan, Dr.Vivekanandhan, Dr.Ravi Kumar, Dr.ArunKumar**, Assistant Professors of this department for their valuable suggestions and help during this study.

I thank all anesthesiologists and staff members of the theatre and wards for their endurance during this study.

I am grateful to all my post graduate colleagues for helping in this study. Last but not least, my sincere thanks to all our patients, without whom this study would not have been possible.

(Dr.Sharan Achar T)

CONTENTS

INTRODUCTION

Fractures of acetabulum are relatively uncommon, but as they involve the major weight bearing joint in lower extremity, they assume great clinical importance. Fractures of acetabulum occur primarily in young adults due to high-velocity trauma and in old age even with trivial trauma. Over the last 25 years, improvements in vehicle safety, pre-hospital care, resuscitation and transport with standardized treatment protocols have all resulted in improved survival following severe pelvic trauma. Only 10% of the pelvic injuries involve the acetabulum.

The displaced acetabular fracture fragments result in hip joint incongruity which in turn leads to abnormal pressure distribution over the articular cartilage surface. This may lead to accelerated breakdown of the articular cartilage, resulting in disabling irreversible arthritis of hip joint.

Acetabular fractures are usually associated with injuries of other parts of the pelvis and lower limbs which influences the treatment options, surgical approaches, clinical and radiological outcomes. Patient age, fracture stability, presence of comorbidities and osteoporosis, along with the surgeon's experience, all influence the treatment options.

For decades non-operative treatment of acetabular fractures had been practiced as not many surgeons comprehended the normal and pathological anatomy of acetabulum together with concept of surgical

approaches for the pelvis. Judet et al [2] in 1960s established the operative treatment of these fractures by continuous improvement of pre-operative evaluation and classification of fractures.

The aim of treatment of these difficult acetabular fractures is concentric reduction of femur head under the weight bearing dome of acetabulum resulting in anatomic reduction and followed by a stable fixation. This can be achieved only by adequately exposing the acetabulum and by rigid internal fixation. Displaced pelvic fractures involving the acetabulum are difficult to treat. With closed methods alone, it is difficult to restore the articular congruity completely and obtain stability, for early mobilization of the hip joint.

The management of acetabular fractures involves a steep learning curve. Definitely it is an enigmatic field in orthopedics that is being continually refined [3].

The purpose of this study is to determine the effectiveness and complications of the surgical management of fracture involving the acetabulum using Kocher Langenbeck, ilioinguinal, iliofemoral or combined approaches in our institution.

AIM OF THE STUDTY

1. To study the outcome, functional and radiological, after surgical reconstruction of acetabular fractures.
2. To study the post-operative complications and failures.

REVIEW OF LITERATURE

Historically, acetabular fractures are relatively uncommon injuries. The severity of acetabular fractures was demonstrated by the fact that earlier descriptions of these injuries were the results of autopsy findings in patients who had sustained significant trauma.

As early as 1821, Cooper reported the first detailed description of a case of acetabular fracture. This case was autopsy findings of a patient with a central dislocation of head of femur into the pelvis.

In 1867, Bernhard von Langenbeck first described his “longitudinal incision for hip infections". He had described it as “from above the ischiatic notch to the middle of the greater trochanter passing between the bundles of the gluteal muscles”.

In 1909, Schroeder gave a detailed compilation of the first 49 cases reported in literature. In 1911, Theodor Kocher described the caudal extension of Langenbeck’s approach. Judet combined the two approaches to create, the now widely used, Posterior Kocher Langenbeck approach later in this paper in 1954.

Throughout the last 20th Century, there was little uniformity in description, classification, the terminologies used and management of acetabular fractures.

Treatment via percutaneously placed schanz pin into the proximal femur to provide lateral traction was described by MacGuire in 1926.

About three months of immobilization and non-weight bearing was recommended at that time.

In 1936, Campbell noted that acetabular fractures were relatively common with dislocation of hip and described its management protocol [3]. In the early 1940s, Levine published his successful results about surgical management, i.e open reduction and internal fixation, of central acetabular fractures [4].

Knight and Smith after their extensive study, suggested that the restoration of the weight-bearing vault of the acetabulum to be the most important aspect of surgery. They also advocated anterior (iliofemoral) approach for horizontal fractures (i.e., transverse-type) and posterior approach for the vertical fracture types (i.e., column-type fracture) [6].

In the 1950s, Thompson and Epstein gave a classification for posterior dislocation of hip joint [5].

In 1961, Rowe and Lowell published their benchmark article titled – "Prognosis of Fractures of the Acetabulum". It was a retrospective study comprising of 93 acetabular fractures in 90 patients, all with a minimum follow-up of one-year. They described a view to evaluate the posterior acetabular fractures with patient placed prone, with the uninjured hip elevated to 60 degree [7].

In 1964, Judet et al published their classic article entitled – "Fractures of the Acetabulum, its Classification and Surgical Approaches

for Open Reduction". This article was a giant leap forward in understanding the complex anatomy of the acetabulum and its fracture classifications. It outlined the use of Anterior-Posterior and two 45˚ oblique views of pelvis to evaluate the pattern of acetabular fractures. These radiographic views, now known as – the Judet views, named after the author, includes the iliac oblique view and obturator oblique view. At present these are the standard radiographic films for evaluation of acetabular fractures [2].

In the early 1980s, Computed tomography was introduced and it was widely propagated by Mears and others.

Letournel held his first ever international course on management of fractures of the acetabulum and pelvis in Paris in 1984. He advocated extensive study of x-rays, to understand the anatomy of fracture pattern and its correct classification, before surgical management of acetabular fractures. Letournel also described the appropriate positioning of the patient in the operation theatre whenever feasible to operate the fracture through a single non-extensile surgical approach[8].

In 1986, Matta using the 45˚ oblique Judet views and the Anterior-posterior views of the pelvis, conceptualized - roof arc measurement. He also printed two articles that helped to establish the modern basis of non-operative line of management of acetabular fractures [9,10].

In 1989, Stoppa narrated a single midline approach for the management of complicated groin and incisional hernias with a Dacron tulle prosthesis support. Cole and Bolhofner illustrated that this Stoppa approach could provide direct exposure to the quadrilateral surface, medial wall and even extend the exposure up to the sacroiliac joint, aiding the safe and effective reduction of the acetabular fractures[11].

Various other authors have advocated numerous treatment protocols and suggested multiple approaches, either simultaneously or sequentially, for certain types of fractures of the acetabulum.

APPLIED ANATOMY

DEVELOPMENT OF ACETABULUM

Early development of the hip begins with formation of the lower limb buds in the 4th week of embryological development. By the end of the 8th week, the blood supply of the developing hip is fully established. By the 16th week, the centers of ossification of the ilium, ischium, and pubis emerge, and the triradiate cartilage is formally created.

The acetabulum and labrum develop much of their final morphological features during infancy and childhood. Between the innominate bones lies a cartilaginous T-shaped **triradiate cartilage**, is responsible for the formation of the anterior wall, posterior wall, and the dome of the acetabulum. The triradiate cartilage is most responsible for the final depth of the acetabulum.

The **os acetabuli** form after 7 years and have completed growth and closed before 9 years. The triradiate cartilage closes at 14-16 years, but the acetabular epiphyses can remain open as late as 18 years.

This **ASIS** lies superior and just lateral to the acetabulum in the coronal plane. It has been called the light house of the hip because of its prominence, and it can be easily palpated, even in obese patients, making it an ideal anterior landmark for the hip.

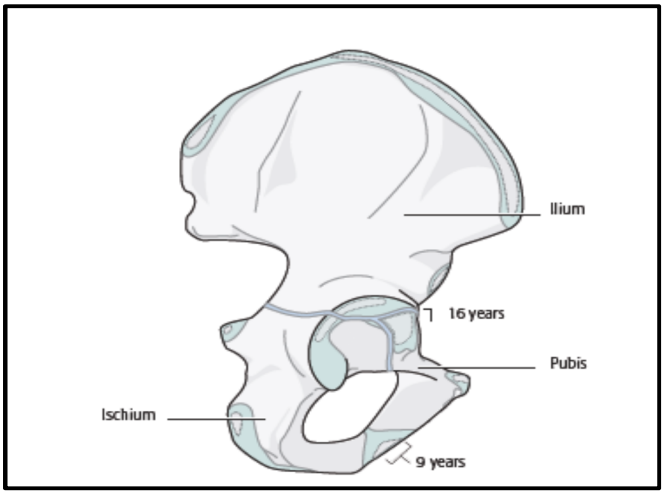
ACETABULAR STRUCTURE

The acetabulum is a complex geometric structure that can be conceptualized as being built from essentially six principal components. These components are as follows:

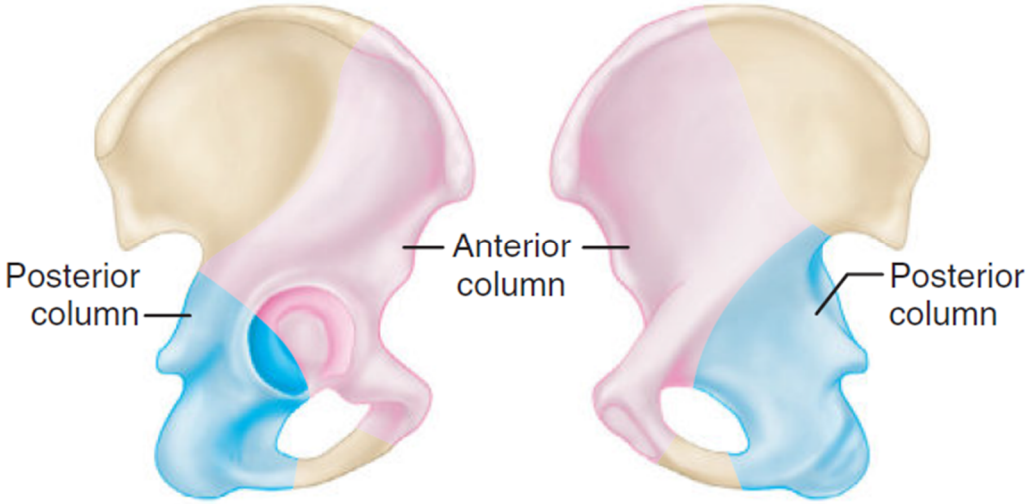
1. Anterior column
2. Posterior column
3. Anterior wall
4. Posterior wall
5. Acetabular dome or tectum (Latin for roof)
6. Medial wall

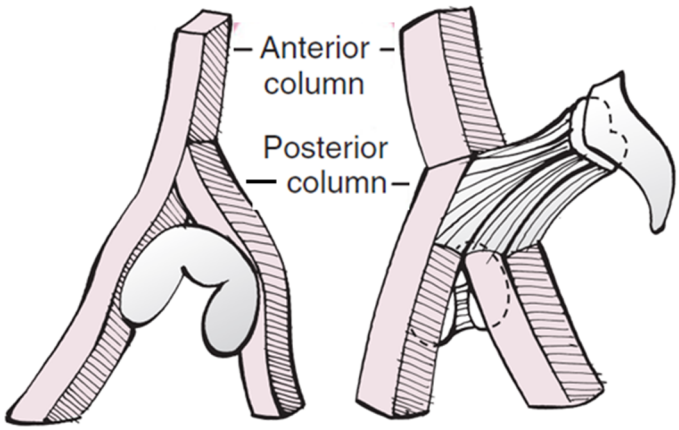
The **cotyloid or acetabular cavity** is formed by the fusion of three bones- ilium, ischium and pubis, to each other centrally. Letournel and Judet described anterior and posterior columns for acetabulum and the innominate bones.

Sciatic buttress is the thick strut of bone lying above the sicatic notch which connects the acetabular columns to the sacroiliac articulation. It forms angle of 60 degrees.



Primary centers of ossification pelvis





The **anterior column** consists of anterior half of the iliac wing that is contiguous with the pelvic brim to the superior pubic rami, as well as anterior half of acetabular articular surface.

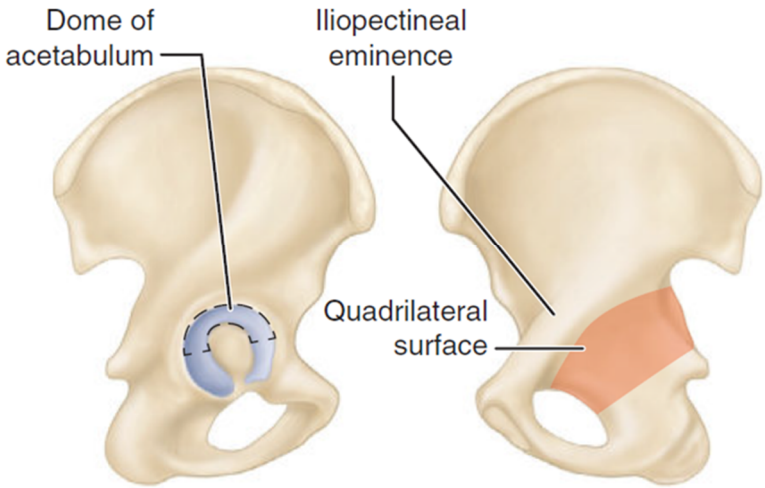
The **anterior wall** is directly connected to the pubis, and the superior pubic ramus extends anteriorly from its medial border. Proceeding medially along the anterior wall, there is an indentation in the anterior wall adjacent to a prominent groove on the pelvic rim. This groove, just lateral to the iliopectineal eminence, provides a track for the iliopsoas.

The **posterior column** begins at the superior aspect of the greater sciatic notch and is contiguous with the greater and lesser sciatic notches inferiorly and includes the ischial tuberosity.

The **posterior wall** extends laterally from this structure. The acetabular socket itself is formed by the anterior wall, the posterior wall, the dome, and the medial wall. The posterior wall is larger and projects more laterally than the anterior wall. Its lateral edge has a nearly vertical but slightly curved route. The posterior wall is the most vulnerable portion of the acetabular structure, lying farthest from the support of the arch of the two columns. It is the most commonly and easily fractured, and the most important for stability.

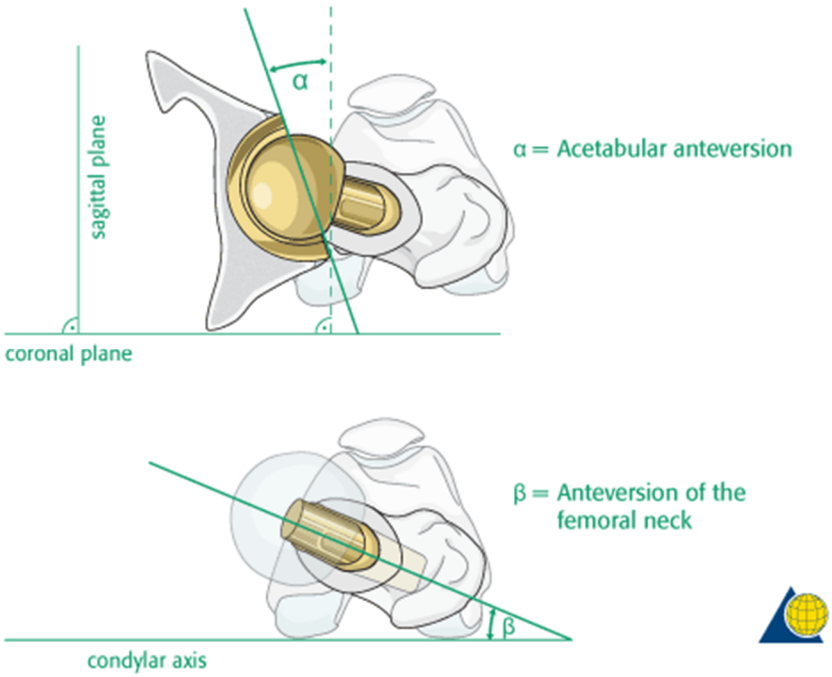
The two columns meet medially to form the **Quadrilateral plate**, which is the internal cortical surface of the acetabulum. The weight bearing dome or roof extends from just posterior to anterior inferior iliac spine to superior aspect of the posterior column. Fracture displacements through this region have great clinical importance, as they must be anatomically reduced

The **medial wall** includes the cotyloid fossa of the acetabulum laterally and the quadrilateral plate medially. The fossa is a central cavity where no articulation occurs and it is filled with a fat pad (called the pulvinar) and the ligamentum capitis femoris (or ligamentum teres). Multiple foramina serve as access for the small arterioles of the acetabular branch of the obturator artery, which runs through the fat pad to both walls and to the dome area.

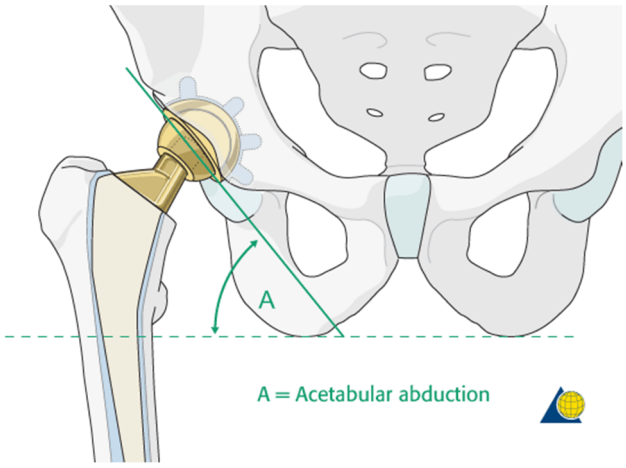


ACETABULAR ORIENTATION

The spatial relationships of the acetabulum to the pelvis can be described in terms of version and inclination. These are especially important for arthroplasty procedures.



Acetabular version



Acetabular inclination

Version is described as the angle between either a central horizontal line connecting the anterior and posterior walls or the averaged opening plane of the acetabulum and the sagittal plane.

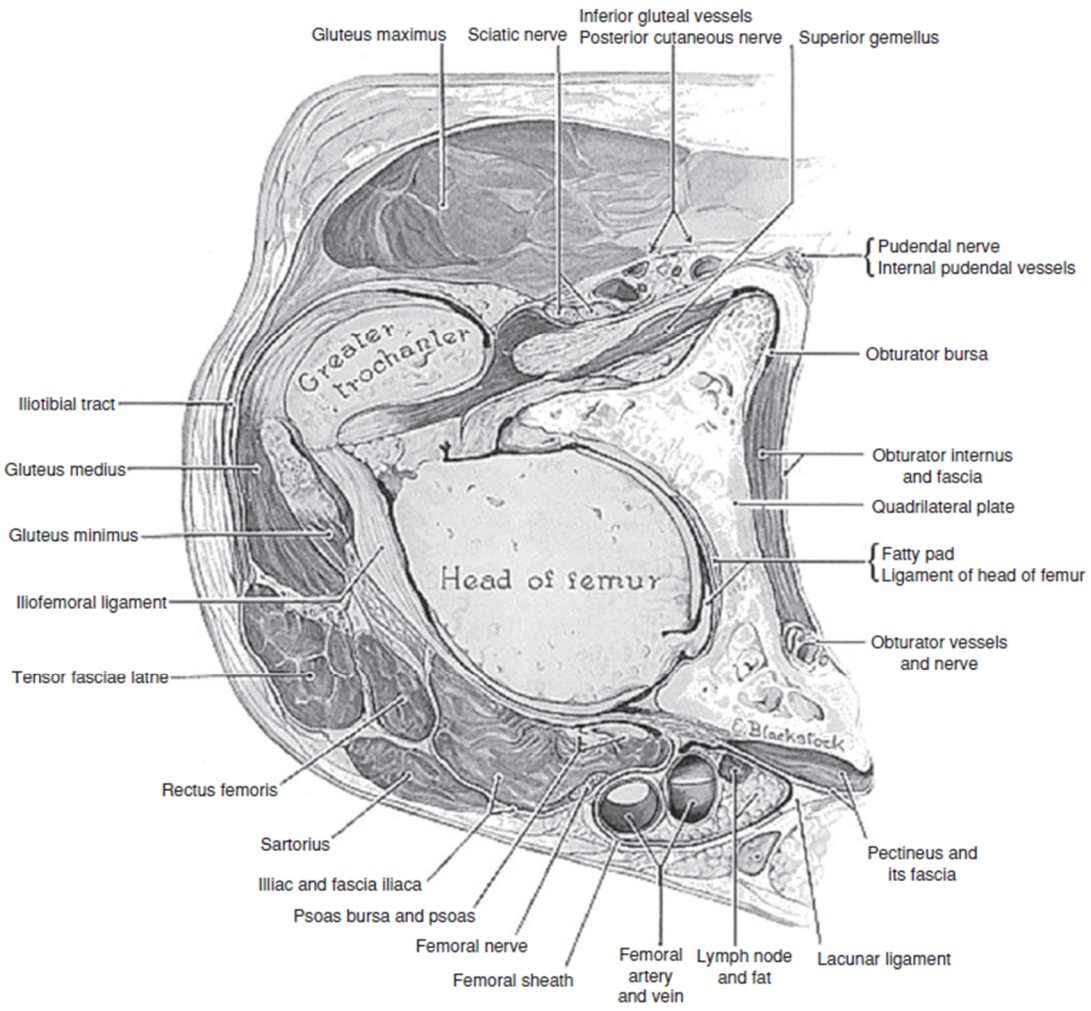
Inclination/ Acetabular abduction is defined as the angle between either a central vertical line connecting the superolateral acetabulum to the inferomedial fossa or the opening plane of the acetabulum and the transverse plane.

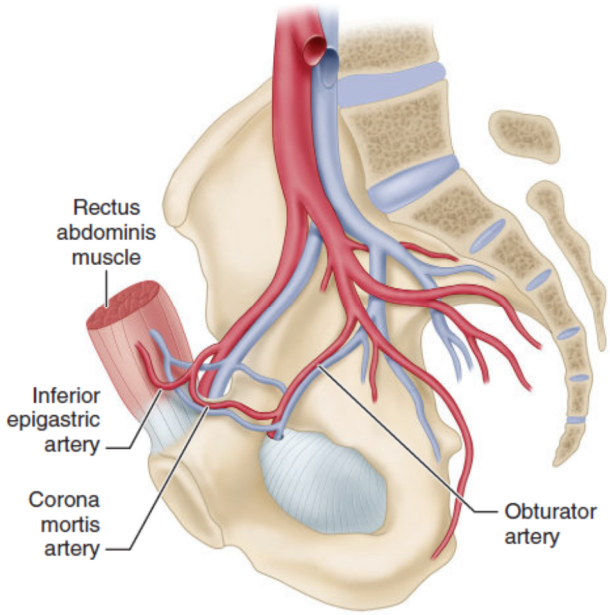
Average anteversion can be from 16−21°. Males tend to have less anteversion than females, 12−20° versus 15−24°. The average inclination can be 48°, with minimal differences between genders.

HIP STABILITY

The posterior wall is the major bony contributor to stability of the hip joint. Trauma research has shown that hip stability depends principally on an intact posterior wall and to a lesser extend an intact capsule.

ANATOMIC RELATIONSHIP OF ACETABULUM





ANTERIOR STRUCTURES

Muscular relations:

The outer layer of abdominal wall is the external oblique muscle. From Anterior Superior Iliac Spine (ASIS), it becomes aponeurotic to form the inguinal ligament and gets attached to pubic tubercle. The Internal oblique and transverse abdominis travels to midline to form rectus sheath.

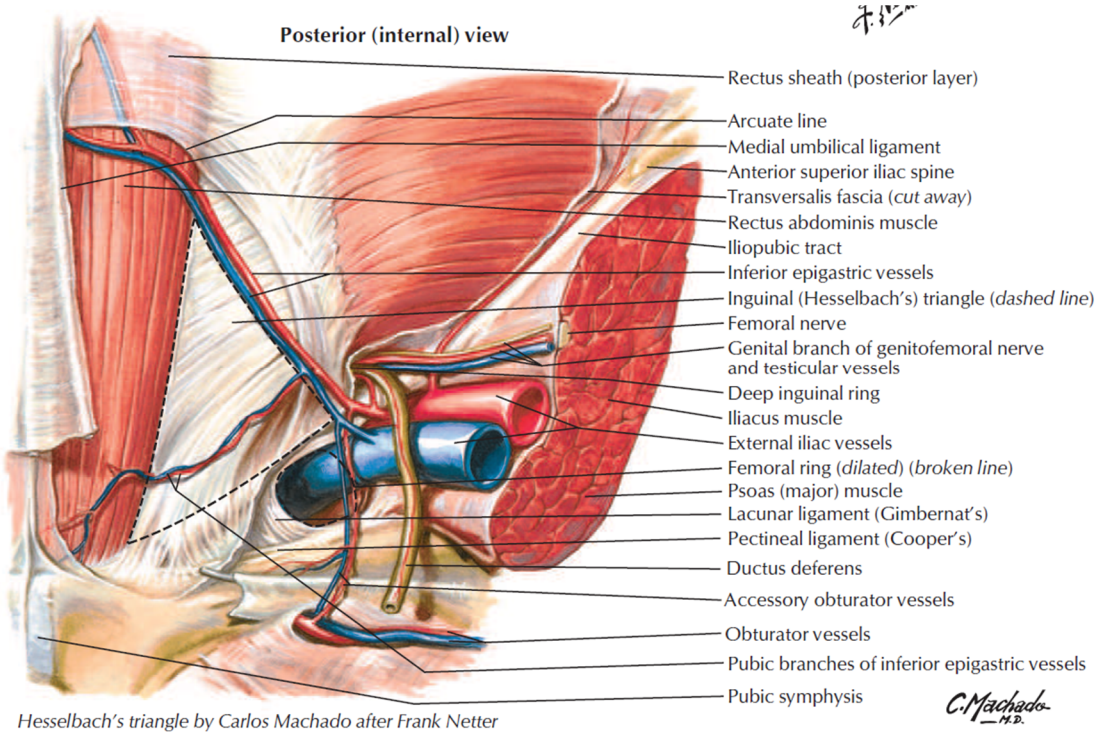
The ***iliopectineal fascia*** is a thick fascial layer covering the surface of the iliacus muscle. It stretches over the pelvic brim from anterior sacroiliac joint till the pectineal eminence. This fascia forms a distinct band between the two compartments below the inguinal ligament, namely– **Lacuna vasculorum** containing femoral vessels and its lymphatics and **Lacuna musculosum** containing iliopsoas muscle, lateral cutaneous nerve of thigh and femoral nerve. In ilioinguinal approach, careful identification and incising the iliopectineal fascia is essential.

Vascular relations:

External iliac vessels arise from common iliac vessels along with its counterpart internal iliac artery. External iliac vessels course anterior and inferior along the psoas major muscle's medial border. They leave the pelvic girdle posterior and inferior to the inguinal ligament dividing

Ilioinguinal approach into the medial and middle window forming an important landmark.

Obturator artery originates from the internal iliac artery. Small caliber anastomoses between the internal and external iliac systems are common. The pubic branch of inferior epigastric artery frequently anastomoses with the pubic branch of the obturator artery behind the body of pubis. In a small variable percentage of these cases, this anomalous vessel is of a large caliber and might result in severe bleeding if it is cut or unknowingly lacerated. This is the so-called **Corona Mortis.**



Hesselbach's triangle by Carlos Machado after Frank Netter

Nerve Relations:

Lateral cutaneous nerve of thigh*:* The lateral cutaneous nerve of the thigh will course 1cm medial to ASIS and needed to be isolated during dissection.

Femoral nerve*:* The femoral nerve runs beneath the inguinal canal lying on the iliopsoas muscle. Take care to avoid vigorous retraction, as stretching the nerve will result in a paralysis of the quadriceps muscle.

Other Relations:

The ***spermatic cord*** contains the vas deferens and testicular artery. Although it is easily mobilized, it must be treated gently during the approach and the closure to avoid ischemic damage to the testicle.

The ***bladder*** can be easily mobilized off the back of the symphysis pubis. Fractures of the lower half of the anterior column may can cause bladder and urethral damage.

POSTERIOR STRUCTURES

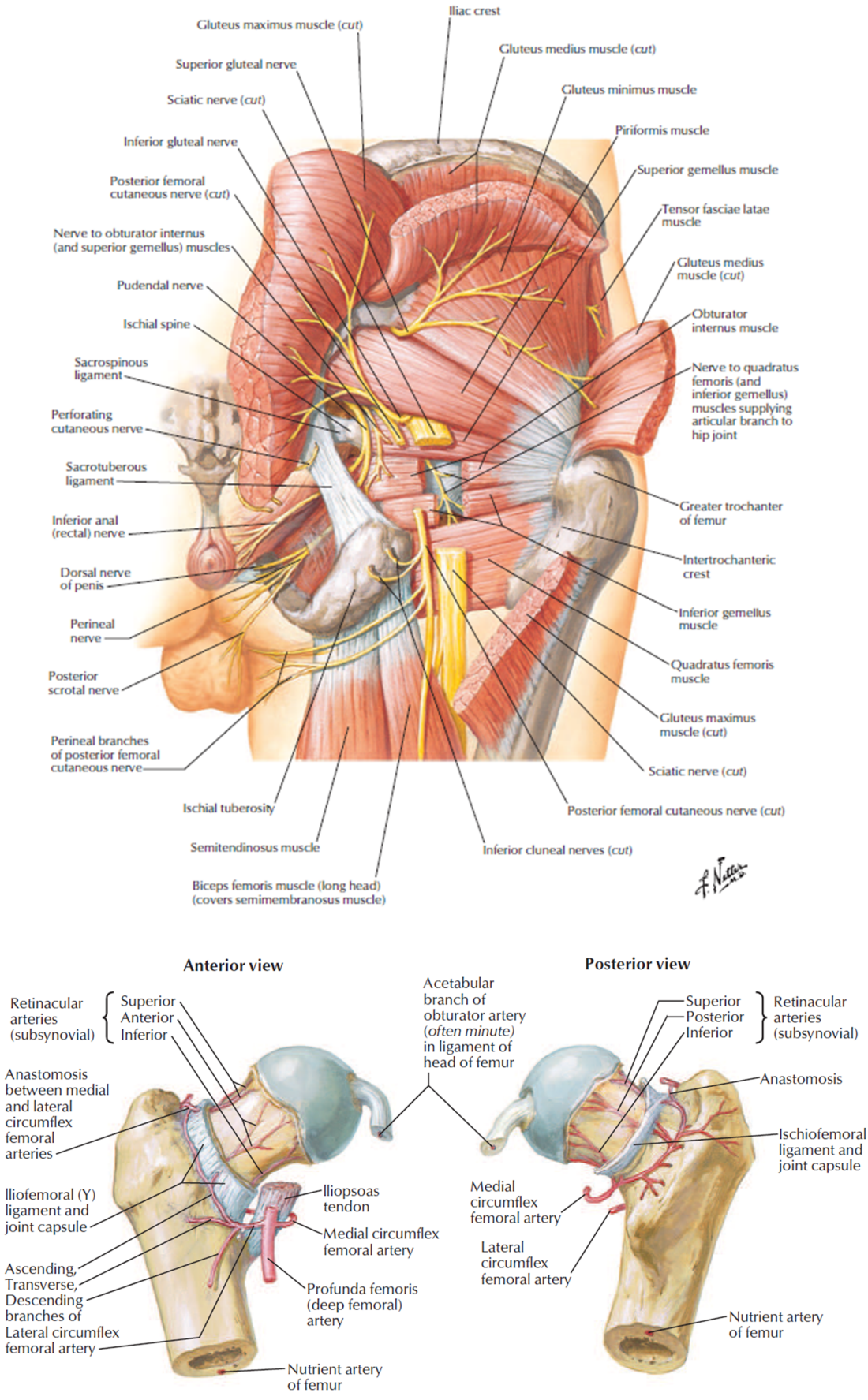
Muscular relations:

The muscles covering the posterior aspect of the acetabulum form two sheaths or layers. The superficial muscle layer consists of gluteus maximus which inserts into the iliotibial tract and gluteal tuberosity. The gluteus maximus sits on the other structures in the buttock like the front cover of a book. As Henry [20] noted, the layer of fascia lata with tensor fascia lata muscle and the gluteus maximus muscle can be viewed as the "pelvic deltoid": it covers the hip much as the deltoid muscle covers the shoulder.

Deeper muscles include- Gluteus medius, which is a fan shaped muscle originating from the gluteal surface of ilium and gets inserted into the greater trochanter. Short external rotator muscles form the inner most layer. They include pyriformis, superior and inferior gemelli, with tendon of obturator internus in between them and distally quadratus femoris.

The critical structures of importance in deep surgical dissection are:

- Superior gluteal vessels and nerve (above pyriformis muscle)
- Inferior gluteal vessels and nerve
- Sciatic nerve
- Quadratus femoris muscle protecting the ascending branch of medial circumflex femoral artery



Blood Supply Of Head Of Femur

Vascular relations:

***Superior Gluteal Vessels*:**

Most commonly injured in greater sciatic notch, by inadvertent placement of Hohmann spike in greater sciatic notch or can be traumatized from aggressive superior or lateral retraction of gluteus medius and minimus muscles in Kocher-Langenbeck approach.

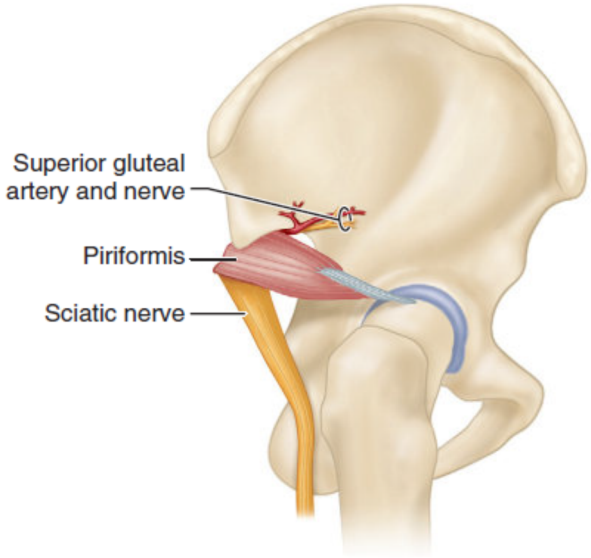
Ascending Branch Of Medial Femoral Circumflex:

It is the principal blood supply to femur head. It lies deep to quadratus femoris muscle, hence during dissection for wider exposure, only proximal 2/3rd part of this muscle is incised. The artery lies superficial to obturator externus.

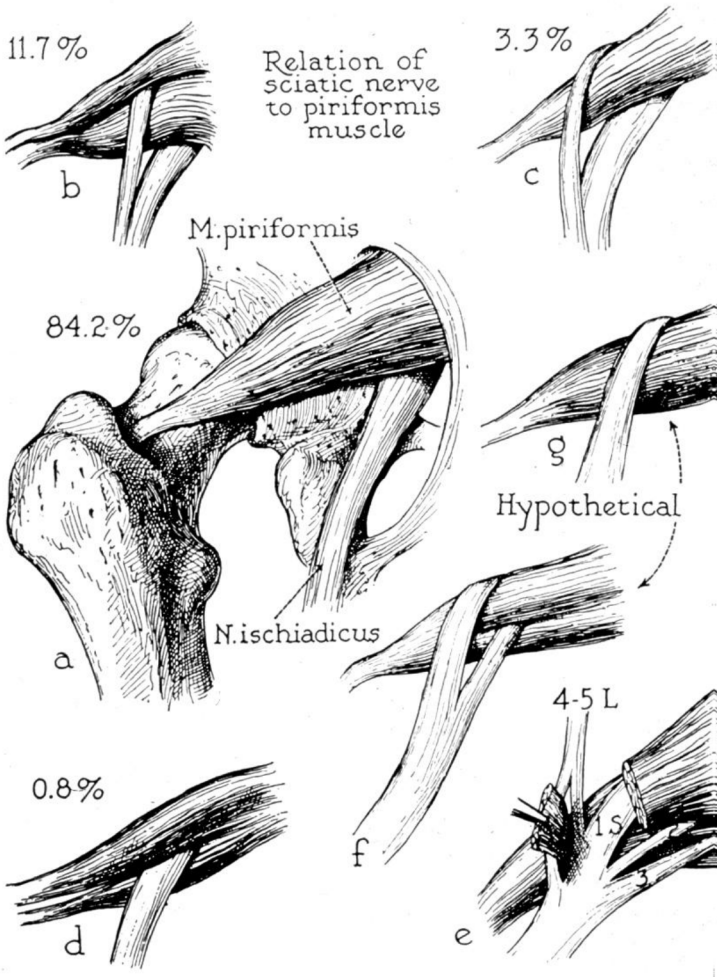
Nerve relations:

Sciatic Nerve:

Most commonly injured by trauma or by iatrogenic nerve injury. It exits the pelvis through the greater sciatic notch passing distal to the pyriformis muscle. Sciatic nerve must be identified, isolated and safe guarded throughout the procedure to prevent post operative foot drop. During surgery the various variations of its course must be kept in mind.



Relation of Pyriformis Muscle



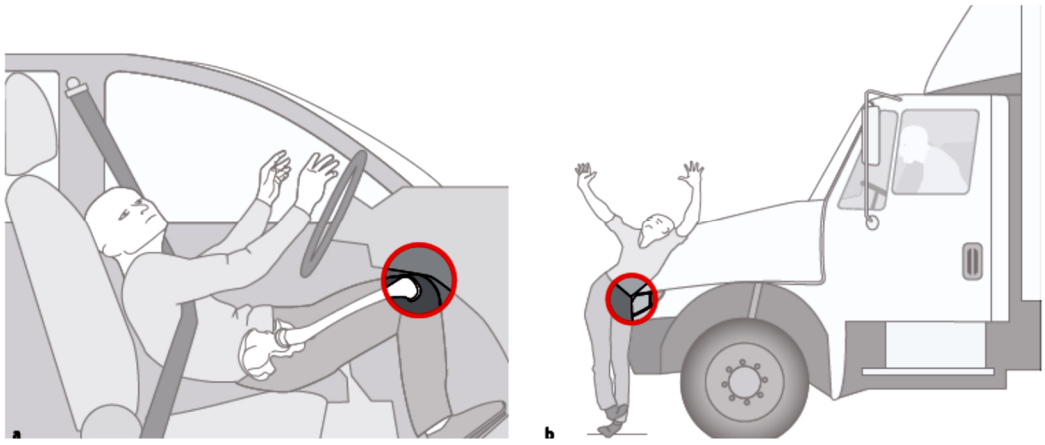
Variations in the course of Sciatic Nerve

MECHANISM OF INJURY

Acetabular fractures occur as the forces are transmitted from femur to the pelvis through the femoral head. Therefore, the fracture pattern is dependent on -

- Position of the hip at the time of injury
- Direction of force applied and
- Magnitude of the impact.

The biomechanical concepts was proposed by Letournel. The amount of internal rotation/external rotation, abduction/ adduction, or flexion/extension at the time of injury can produce different types of fractures. This accounts for numerous possible fracture types. The injurious force may be applied to the flexed knee and along the femoral shaft—as in the dashboard injury or to the greater trochanter (lateral force), to the foot, or to the lumbosacral area.



a. Dashboard Injury with the hip flexed position.
b. Direct Injury by forces applied directly to the great trochanter

FRACTURE PATTERN BASED ON FORCE APPLIED

Force	**Hip Abduction**	**Hip Rotation**	**Fracture pattern**
Along the femoral neck	Neutral	Neutral	Anterior column with posterior hemi-transverse
	Neutral	25˚ ER	Anterior column
	Neutral	50˚ ER	Anterior wall
	Neutral	20˚ IR	T shaped
	Neutral	50˚ IR	Posterior column
	Adduction	20˚ IR	Transtectal transverse
	Adduction	20˚ IR	Juxta/ infratectal transverse
Along the femoral shaft Hip flexed 90˚	Neutral	Any	Posterior wall
	Adduction	Any	Transverse with posterior wall
	Adduction	Any	Posterior dislocation
Along the femoral shaft Hip extended	Neutral	Any	Posterosuperior wall fracture
	Adduction	Any	Transtectal transverse

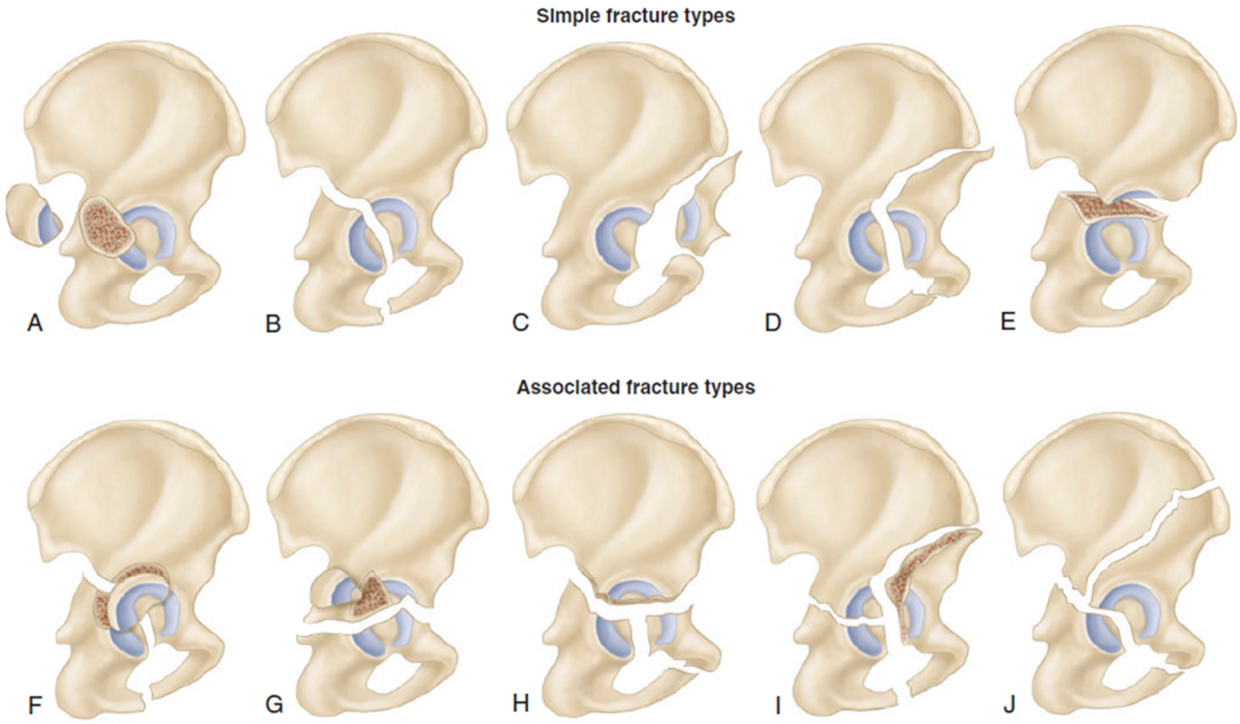
ER-External Rotation IR-Internal Rotation

Courtesy: Rockwood and green, Fracture in adults 8th edition

FRACTURE CLASSIFICATION

Classification of acetabular fractures is the pivotal step in understanding the mechanism injury and is the first step of planning the surgery. The fracture anatomy is the main point which dictates the choice of surgical approach and the fixation techniques.

In our Institution, we followed Judet and Letournel classification because it is simple and useful in surgical planning.



Letournel and Judet classification of acetabular fractures. **A,** Posterior wall fracture. **B,** Posterior column fracture. **C,** Anterior wall fracture. **D,** Anterior column fracture. **E,** Transverse fracture. **F,** Posterior column and posterior wall fracture. **G,** Transverse and posterior wall fracture. **H,** T-shaped fracture. **I,** Anterior column and posterior hemitransverse fracture. **J,** Complete both-column fracture.

JUDET AND LETOURNEL CLASSIFICATION

ELEMENTARY TYPES

1) Anterior wall
2) Anterior column
3) Posterior wall
4) Posterior column and
5) Transverse fractures.

ASSOCIATED FRACTURE TYPES

1) Combined posterior column and wall fractures
2) Combined transverse and posterior wall fractures
3) T type fractures
4) Anterior column fractures with a hemitransverse posterior fracture and
5) Both-column fractures.

Tile described a modification of Letournel‘s classification .This enabled these complex fracture patterns to be categorized into the A, B, and C types. This formed the basis for comprehensive classification of fractures developed by the Arbeitsgemeinschaft Fur Osteosynthesefragen.

COMPREHENSIVE CLASSIFICATION OF ACETABULAR FRACTURES

Type A: Partial articular fractures, one column

A1 - Posterior wall fracture

A2 - Posterior column fracture

A3 - Anterior wall or anterior column fracture

Type B: Partial articular fractures, transverse

B1 - Transverse fracture

B2 - T-shaped fracture

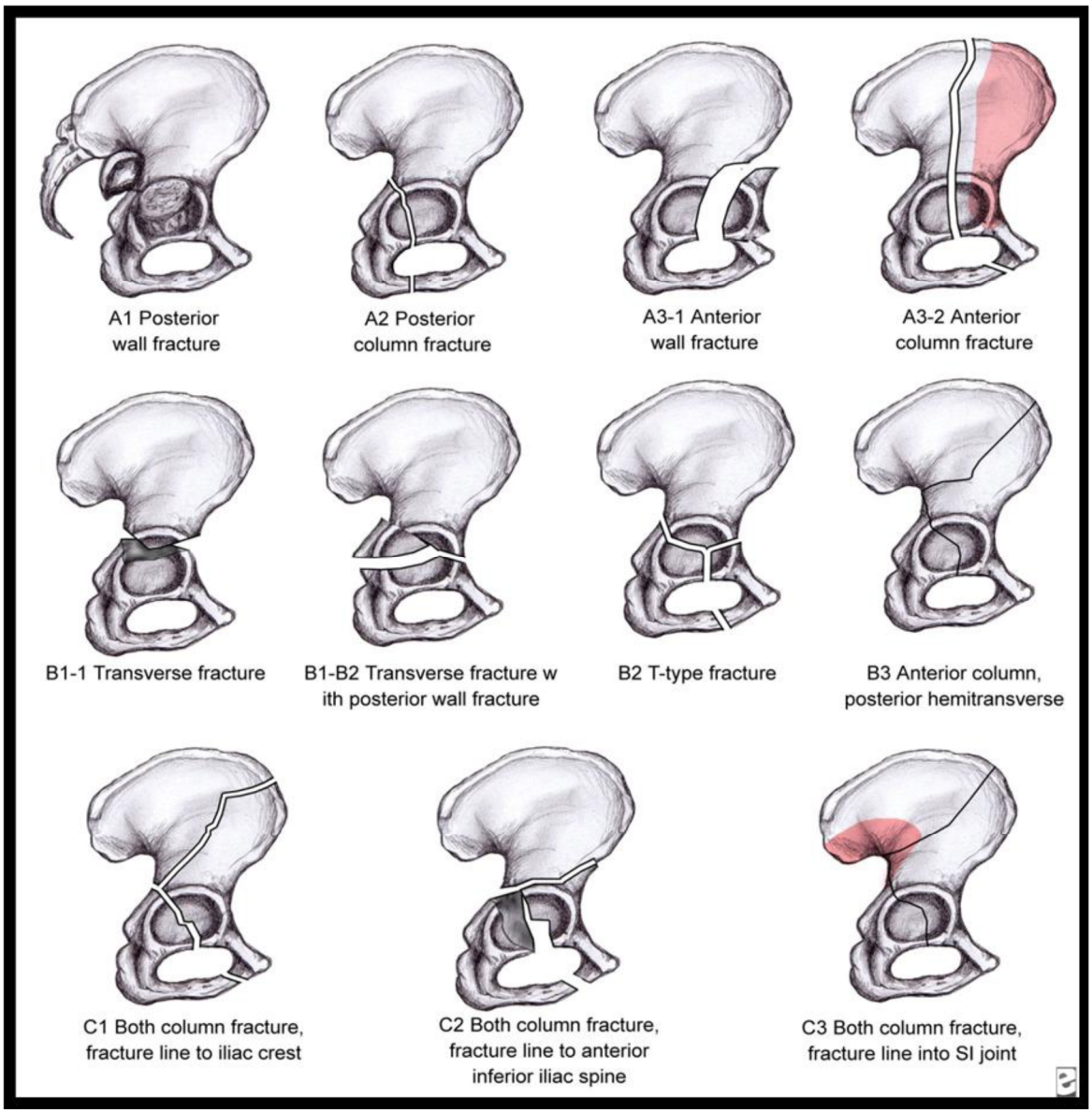
B3 - Anterior column and posterior hemitransverse fracture

Type C: Complete articular fractures, both columns

C1 - High

C2 - Low

C3 - Involving sacroiliac joint



COMPREHENSIVE CLASSIFICATION OF ACETABULAR FRACTURES

CLINICAL AND RADIOLOGICAL ASSESSMENT

On receiving the patient in causualty, the general condition was assessed quickly. Primary survey was done with respect to standard ATLS guidelines namely assessing the Airway, Breathing and hemodynamic status. Secondary survey consisted of detailed skeletal examination, examination of abdomen and pelvis and CNS after resuscitating the patient.

History was important as the mode of injury gave the direction of force and its magnitude, based on which the pattern, displacement and fracture cominution could be decided. Hence history was taken in detail.

A thorough physical examination included inspection for external injuries, bruises, contusions and other wounds. Special attention was taken to look for bleeding per urethrae, Morel-Lavallee lesion, rectal tears and other perineal injuries. Attitude of the injured limb was noted and its distal neurovascular status was documented.

Rectal examination was done for ruling out rectal injuries and central dislocation of head of femur which could be palpated as a globular mass.

RADIOLOGICAL INVESTIGATIONS

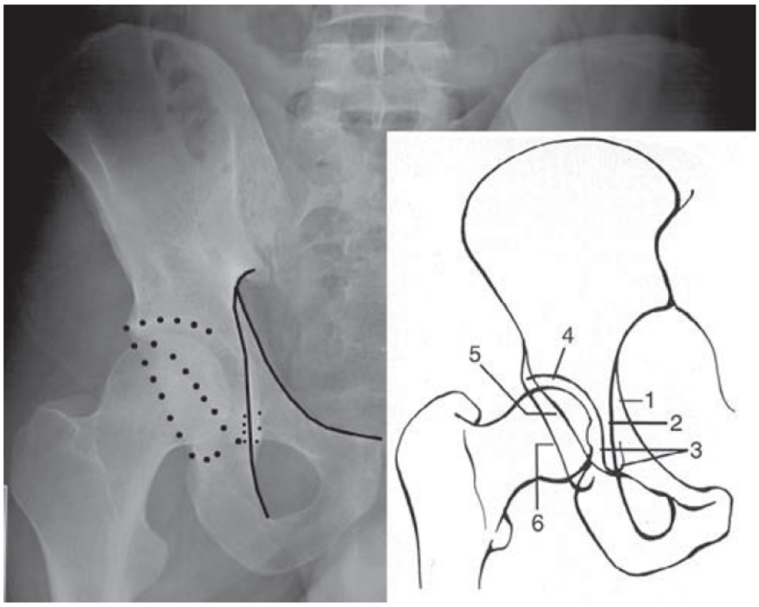
After complete clinical assessment, patient was shifted for radiological analysis if the patient was hemodynamically stable.

Three radiographic views of acetabulum and Computed Tomography Scan formed the standard protocol.

1) Anteroposterior pelvis
2) Judet views- obturator and iliac oblique views.
3) CT scan

ANTEROPOSTERIOR PELVIS

The following lines were looked in anteroposterior view:



1- Iliopectineal line

2- Ilioischial line

3- Teardrop

4- Acetabular roof

5- Anterior rim

6-Posterior rim of acetabulum

- The ***Sourcil*** represents the superior most portion of the acetabular dome.

- ***Iliopectineal line*** is the major landmark of the anterior column. The anterior three-quarters of the iliopectineal line represent the pelvic brim. The posterior quarter of this line is formed by the internal cortical surface of sciatic buttress and the internal part of the roof of the greater sciatic notch.
- ***Ilioischial line*** is formed by the posterior portion of the quadrilateral surface (internal cortical surface of the acetabulum) and is considered a radiographic landmark of the posterior column.
- ***Acetabular roof*** consists of superior weight bearing dome of the acetabulum.
- ***Teardrop or the radiographic U*** consists of two limbs and represents a radiographic finding and not a true anatomic structure. The lateral limb represents the inferior aspect of the anterior wall and the medial limb is formed by the obturator canal and the anteroinferior portion of the quadrilateral surface.
- ***Anterior / posterior walls:*** The anterior rim is typically medial to the posterior rim and has a characteristic undulation in its midcontour in the AP pelvis view. The posterior rim approximates a straight line, being more vertical than the anterior wall

- Other associated pelvic fractures, sacral fractures, pubic diastasis, femoral head fractures and hip joint congruency can also be visualized.

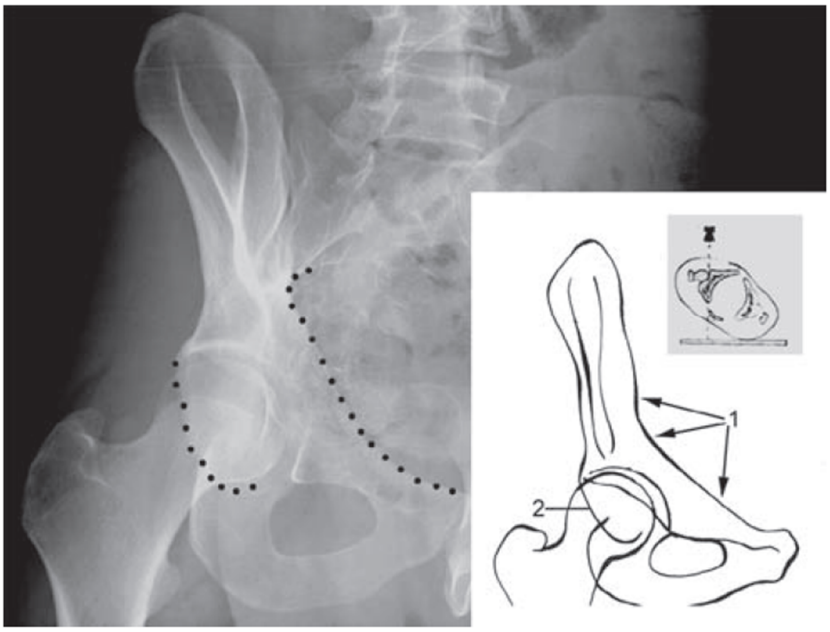
JUDET OBLIQUE RADIOGRAPHS

Judet views are 45° oblique pelvic radiographs which highlight the acetabular columns and walls. Coccyx tip forms an important reference point as it should lie above the center of the femoral head to ensure adequate rotation.

OBTURATOR (INTERNAL) OBLIQUE

This view is taken with affected side tilted up. The following points are noted:

- Obturator foramen in its largest dimension.
- Highlights pelvic brim, anterior column and posterior wall.
- Comparison of the relationship of the femoral head with the posterior wall on the normal hip and the injured hip on the obturator oblique view will allow to detect subtle amounts of posterior subluxation. A dislocated hip will become more obvious on the obturator oblique view.



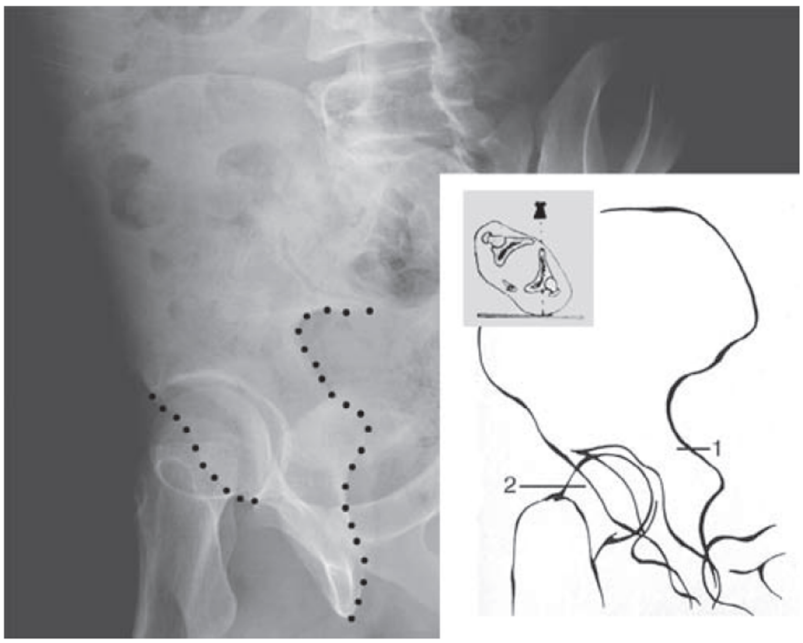
1- Iliopectineal line/ Anterior column

2- Posterior wall

ILIAC (EXTERNAL) OBLIQUE

This view is taken with affected side down. It shows

- The iliac wing in its largest dimension.
- Profiles the greater and lesser sciatic notches, as well as the anterior rim/ wall.



1- Ilioischial line/ Posterior column

2- Anterior wall

- Posterior column involvement is often best seen in this view.
- Fractures of the anterior column traversing the iliac wing can also be detected.

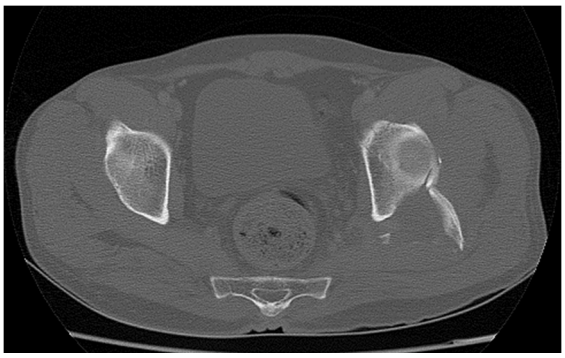
CT SCAN

CT scan helps in detecting the fracture lines that are not visualized in radiographs. Orientation of various fracture line, vertical portion of T-type acetabular fracture and fracture fragment rotation are well made out. CT scan also provides additional information regarding

- Degree of fracture cominution and Intra-articular loose fragments
- Marginal impacted fragment and Joint Congruence
- Sacroiliac joint and the posterior pelvic ring
- Position of the femoral head and its lesions

3-D CT SCAN

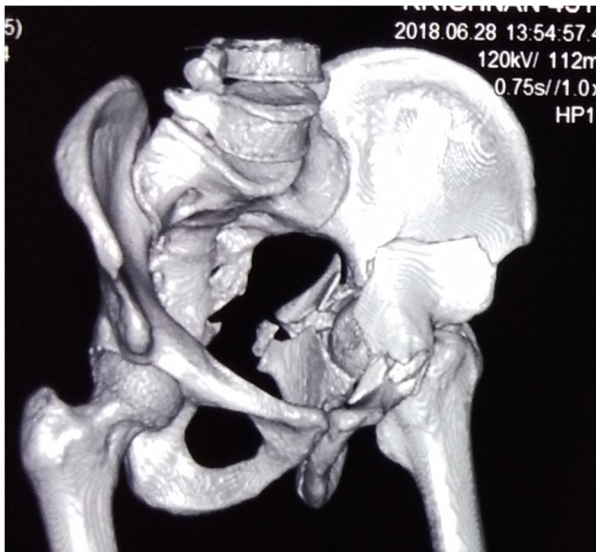
It is converted from data of 2 dimensional CT scan. 3D CT provides a good overall picture of the fracture configuration by permitting subtraction of femur and varying the degree of rotation of pelvis.

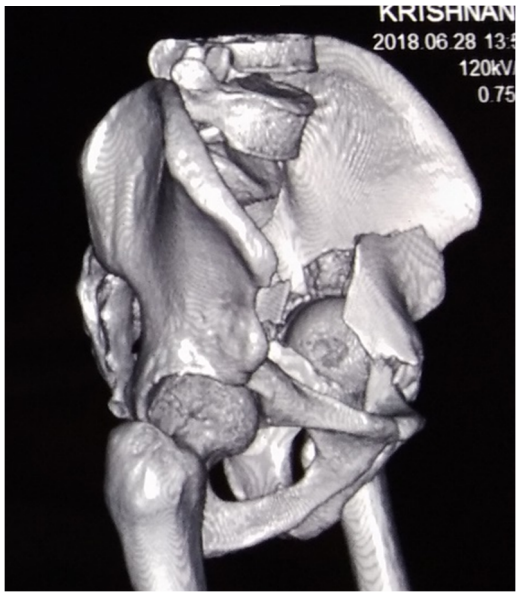


Axial section

Coronal section

Sagittal section





3D reconstruction

SURGICAL EXPOSURES

As in all surgeries, surgical exposure assumes great significance, as accurate reduction and stable fracture fixation is possible only with good surgical exposure.

Extensile approaches like triradiate and extended iliofemoral approach have more complications like vascular compromise to abductors, skin necrosis and heterotopic ossification in particular. Only non-extensile approaches either alone or combined was used in our study. They were:

1) Posterior Kocher Langenbeck approach:

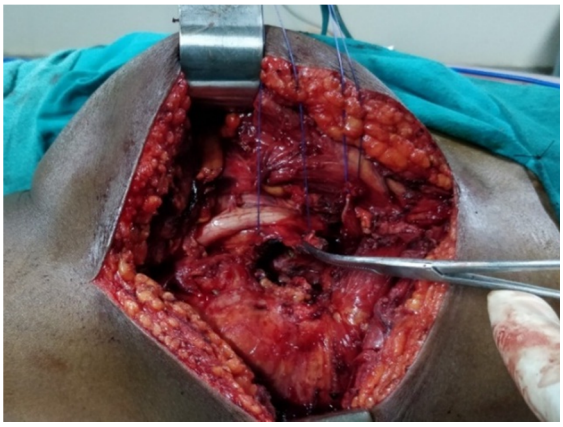
Prone position- Most commonly used

Lateral position

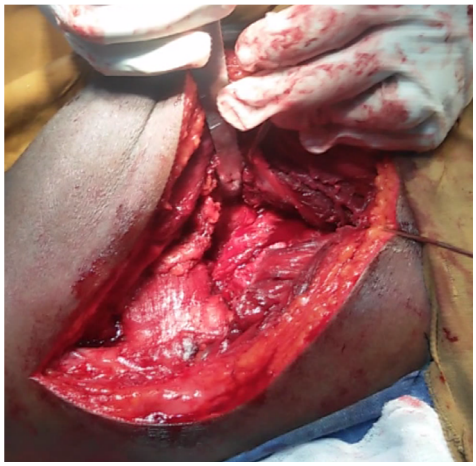
Skin incision was started inferior and lateral to the posterior superior iliac spine, extended in a J shaped manner to the greater trochanter, and then continued to the midpoint of thigh along the axis of the femur.

Gluteus maximus muscle was bluntly divided along the skin incision. Its insertion to femur is released.

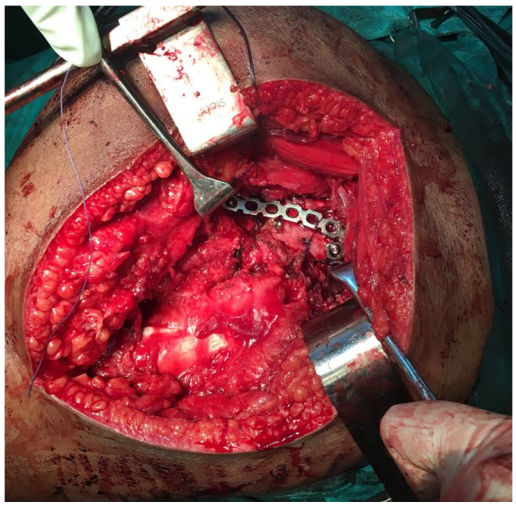
The sciatic nerve was identified on the posterior aspect of the quadratus femoris muscle and followed proximally until it disappears in greater sciatic notch beneath the piriformis. The short external rotators and pyriformis tendon were tagged and divided.



The knee joint was kept in adequate flexion through out the procedure to prevent iatrogenic sciatic nerve palsy. The retractor is positioned is placed in lesser sciatic notch.



Subperiosteal elevation was done to expose the iliac wing inferior aspect. Fracture was reduced and fixed with contoured reconstruction plate with lag screws.

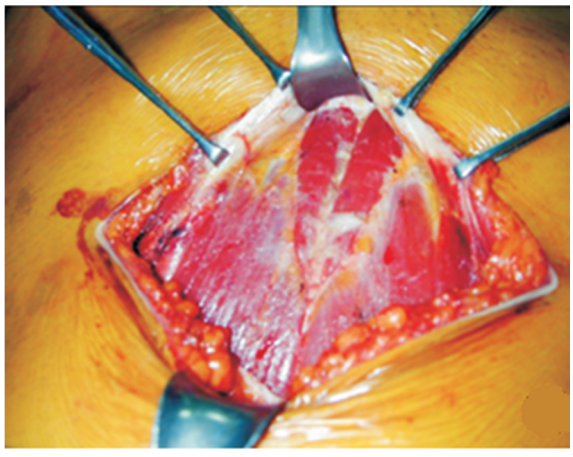


ANTERIOR APPROACHES

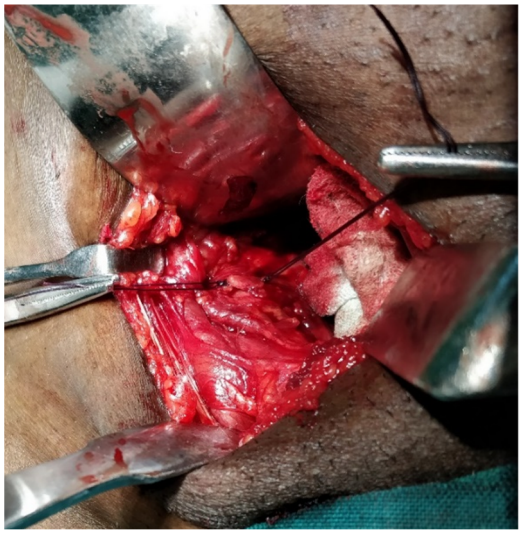
2) Modified Stoppa's with Iliofemoral lateral window:

Stoppa's approach:

A transverse Pffanensteil incision is made 2cms above the symphysis. The linea alba is incised at the midline and split vertically from inferior to superior, remaining extra-peritoneum throughout.



Rectus abdominis is partially dissected from its origin from pubis and retracted laterally.



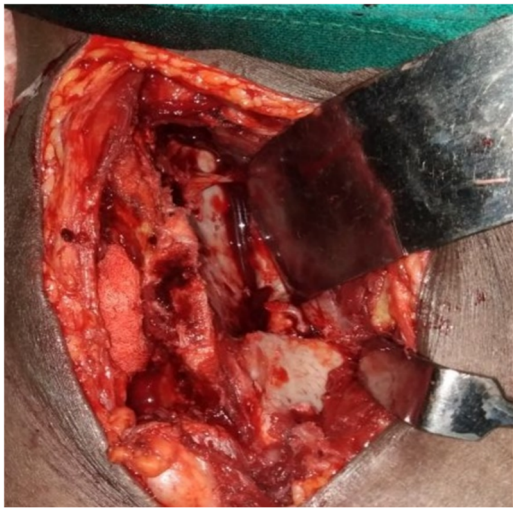
Corona mortis is identified and ligated. Full access is then developed from anterior to posterior along the pelvic brim, sharply dividing and elevating the iliopectineal fascia superiorly and the obturator fascia inferiorly.

Obturator nerve is identified. This approach provided improved exposure of the quadrilateral surface and posterior column.

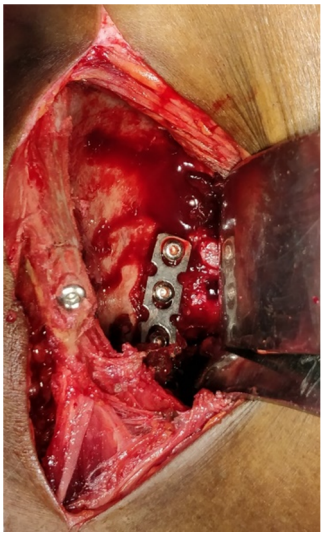
The fracture site is exposed, reduced using ball tipped spike. Reduction is aided through the lateral window.

Iliofemoral lateral window:

Skin incision extends from just posterior to gluteus medius tubercle, along the iliac crest, to anterior superior iliac spine and then extended distally along the sartorius muscle lateral border. Predrilled ASIS was osteomised.

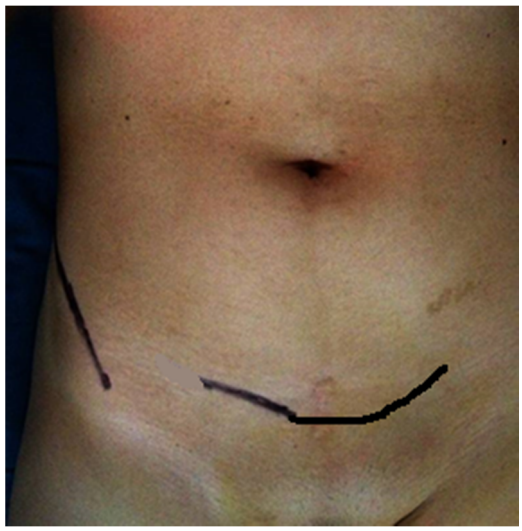


The lateral femoral cutaneous nerve was identified and protected through the entire procedure. The lateral window was exposed by subperiosteal elevation of iliacus muscle from the internal iliac fossa.



3) Modified Stoppa with Ilioinguinal lateral window:

Ilioinguinal approach:



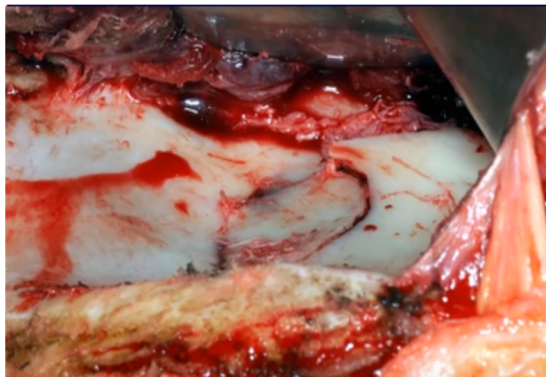
Skin incision similar to iliofemoral, but the incision is coursed along inguinal ligament towards midline and anterior superior iliac spine is not osteomised.

Anterior Ilioinguinal approach has 3 windows:

i. Lateral window: exposed by subperiosteal elevation of iliacus muscle from the internal iliac fossa.

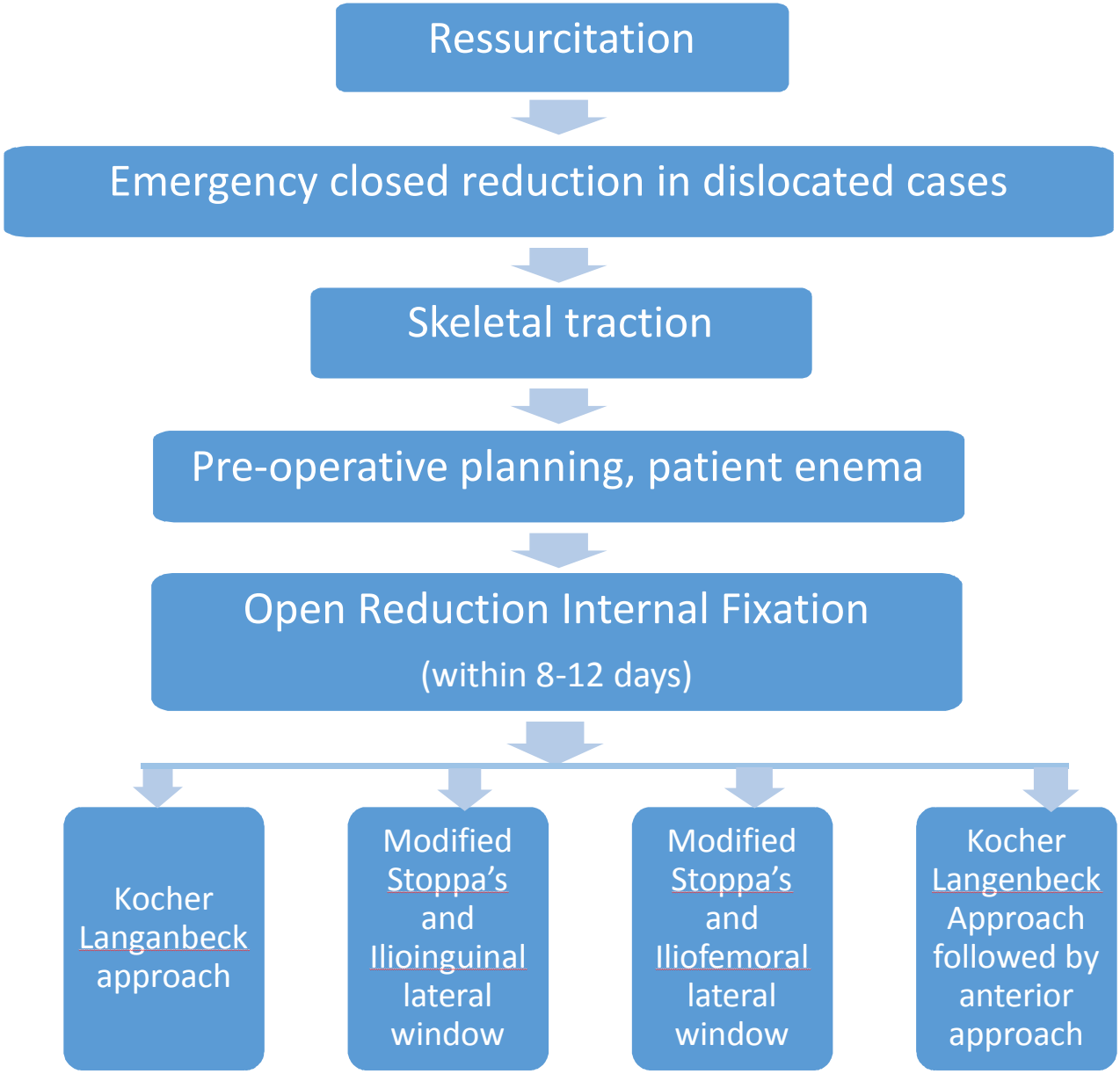
ii. Middle window: created by release of iliopectineal fascia, retraction of iliopsoas & femoral nerve laterally and the external iliac artery & vein medially

iii. Medial window: lateral retraction of the vessels with medial or lateral retraction of spermatic cord.



We have used ilioinguinal lateral window only combined with stoppas approach.

TREATMENT PROTOCOL



GENERAL ASSESSMENT AND RESUSCITATION

In this study, on receiving patients in the emergency ward, general primary survery and resuscitation was done. Once stabilization of vital parameters was done, complete survey of the skeletal and associated injuries was done with special importance to vascular and nerve injuries.

Radiological assessment was done with the standard protocol consisting of anteroposterior, judet views and computed tomography with 3-d reconstruction of acetabulum.

For hip dislocation cases, emergency closed reduction under i.v sedation. Skeletal traction either in the form of distal femur pin traction or upper tibial pin traction was applied in all the patients and was maintained till the day of surgery.

PRE OPERATIVE PLANNING:

Detailed pre-operative planning was done in all the cases regarding the fracture classification, major displacement, preferred approach, reduction technique and mode of fixation.

Preoperative templating was done in a few anticipated difficult anterior column fractures.

SURGICAL EXPOSURE

The approach for each was decided based on

- Fracture side with major displacement dictated the first approach
- The necessity for another approach was decided by post operative radiological assessment of the first approach
- Intra operative fracture stability assessed under C-arm was also taken into account for other approach

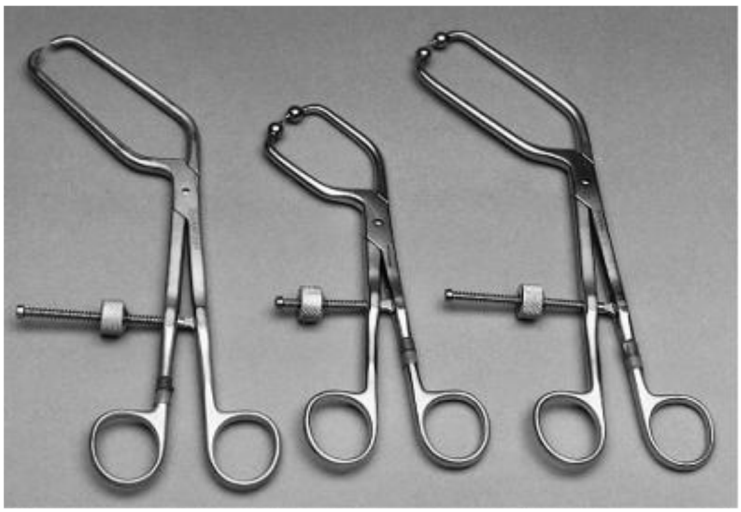
In case of transverse fractures, the approach was decided depending the side with proximal oblique end of fracture. Kocher

Langenbeck approach was used for posterior fractures and Modified Stoppa's approach with lateral window was used for anterior fractures.

REDUCTION TECHNIQUES

After exposure, fracture reduction poses a challenge. Reduction can not be easily achieved as in any long bones and required maneuvers are not the same. Various reduction clamps are present to facilitate reduction and maintain it. In posterior Kocher Langenback approach, schanz pins placed in ischial tuberosity, trochanter and iliac crest was used for simultaneous manipulation. In anterior approaches, a schanz pin inserted in iliac crest or a farabeuf clamp aided manipulation and reduction. Matta's Quadrangular clamp of numerous sizes and with various offsets and Picador ball spike pusher are important instruments in all acetabular surgeries. Fracture reduction was fixed with lag screws whenever feasible. Lagging was done with varied length 4mm cancellous or 3.5 mm cortical screws with washer. 3.5mm Reconstruction plates were used as buttress or neutralistion plates.

INSTRUMENTS

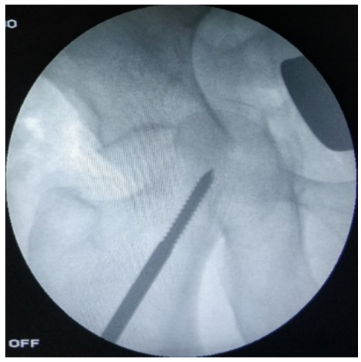


Matta’s Quadrangular clamps

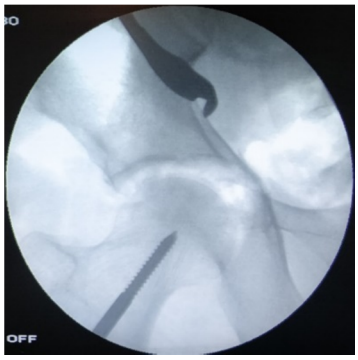
Picador ball spike pusher with pusher

Contouring the plate

REDUCTION TECHNIQUES



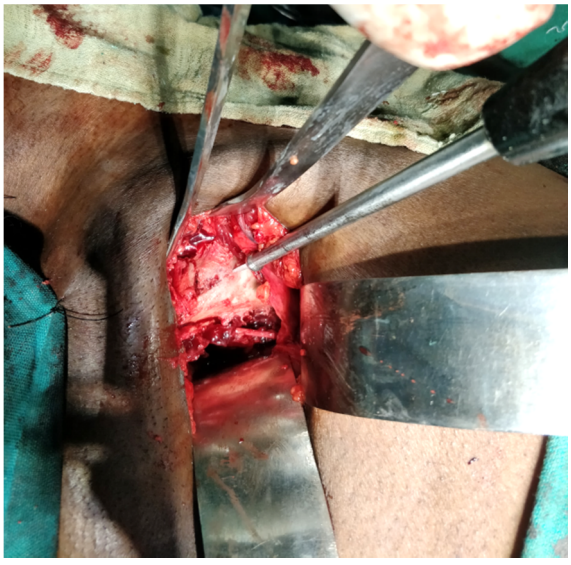
Without traction

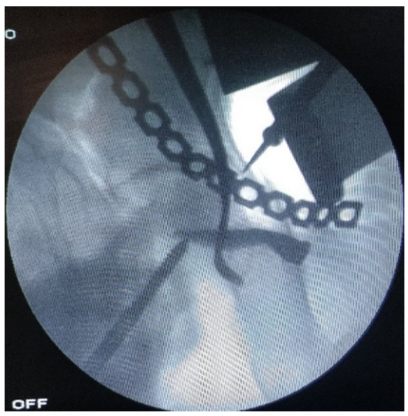


With traction

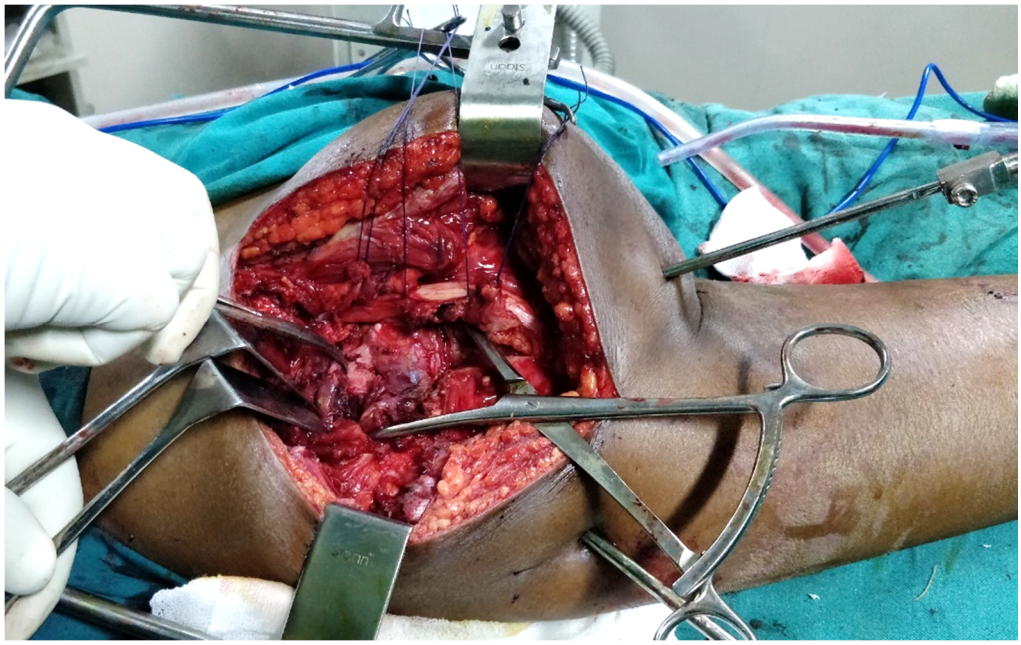
Manual longitudinal traction

Lateral traction through a schanz pin in the greater trochanter

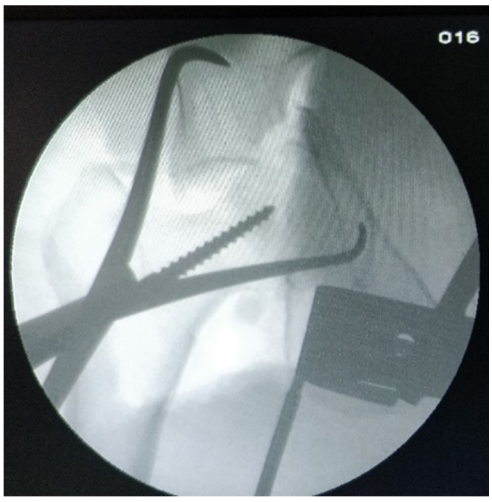




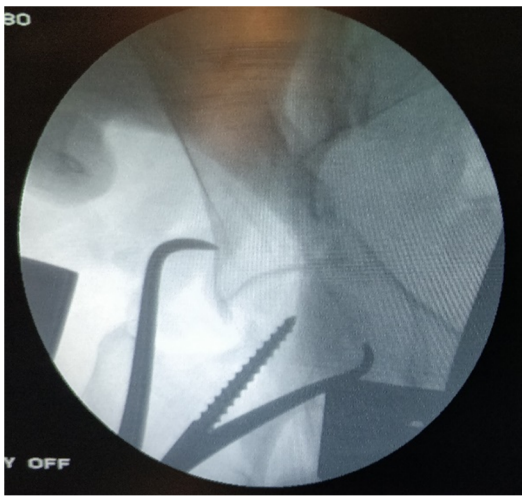
Ball spike pusher for the reduction of displaced anterior column fractures



For manipulation of inferior segment in transverse fractures, a schanz pin inserted through the ischial tuberosity is used.



Without traction



With traction through both trans trochanteric and trans ischial schnaz pins

POST OPERATIVE PROTOCOL

- IV antibiotics was administered to all patients pre-operatively and post operatively for 5-7 days.
- Drain was removed on 2nd post-operative day.
- Passive mobilization was begun on post operative day 5.
- Active movements was started according to pain tolerance.
- Suture removal done on day 12 to 14.
- Tab Indomethecin 25mg TDS 6 weeks prophylaxis was prescribed orally from next day after surgery to prevent heterotrophic ossification.
- Weight bearing was started only after radiological signs of fracture union was confirmed, at around 3rd or 4th month post op.
- Clinical follow-up was be done at 2weeks, 4 weeks, 8 weeks, 4months, 6months, 12months intervals regarding healing of fracture, pain, and functional evaluation. Functional outcome was assessed in each follow up by Modified Merle‘d Aubinge Postel score.
- Radiological follow up by X ray was be done at 2weeks, 4 weeks, 8 weeks, 4months, 6months, 12months intervals in accordance with symptoms and its assessment was done post operatively by Matta‘s criteria.

ANALYSIS

Patients in this study were analysed by Matta's radiographic assessment and modified Merle d'Aubigné and Postel Hip Score at each of the follow ups.

Functional Outcome:

Modified Merle'd Aubigné And Postel Grading System:

Criteria: 1) Pain

a. None - 6
b. Slight or intermittent - 5
c. After walking but resolves - 4
d. Moderately severe but patient is able to walk - 3
e. Severe, prevents walking - 2

2) Walking

i. Normal - 6
ii. No cane but slight limp - 5
iii. Long distance with cane or crutch - 4
iv. Limited even with support - 3
v. Very limited - 2
vi. Unable to walk - 1

3) Range of movements*

a. 95-100% - 6
b. 80-94% - 5
c. 70-79% - 4
d. 60-69% - 3
e. 50-59% - 2
f. <50% - 1

*The range of motion was expressed as a percentage value for the normal hip. This was calculated by obtaining a total of the range of movements, in degrees, of abduction-adduction, flexion-extension and external-internal rotation for the injured hip and dividing it by the total for the normal hip.

Clinical grade:	Excellent	-	18
	Good	-	15, 16 or 17
	Fair	-	13 or 14
	Poor	-	<13

Post-operative Radiological assessment:

Matta's criteria

1) Anatomic reduction - <1mm
2) Imperfect - 1–3mm
3) Poor - >3mm

METHODS AND MATERIALS

This is a prospective study conducted to analyse the functional and radiological outcome of fractures of acetabulum treated by open reduction and internal fixation in 15 patients over a period of two years from May 2016 to September 2018 at Our Institute of Orthopaedics and Traumatology , Coimbatore medical college and hospital, Coimbatore.

After obtaining clearance and approval from the institutional ethical committee and patients fulfilling the inclusion / exclusion criteria were included in the study after obtaining informed consent.

Detailed history was obtained using study proforma with special attention to mechanism of injury. Evaluations including base line investigations. Examination of other associated symptoms was based on history and physical examination.

Collection of data of patients presenting with fracture of acetabulum were as follows.

- History.
- Clinical examination both systemic and local.
- Radiological examination using X-ray, CT (computerised tomography) scan and other imaging modalities if necessary.
- Investigations –Baseline and others.

- Diagnosis - Clinical and radiological.
- Surgery - open reduction internal fixation of acetabular fracture
- Routine antibiotics and analgesics/anti-inflammatory drugs.
- Post operative evaluation by clinical examination and X ray.
- Assessment of complications.
    - Preoperative –difficulty in reduction, hypotension
    - Immediate post operative –Acute Renal Failure (ARF), pulmonary embolism, fat embolism, cardiovascular compromise (MI)
    - Late post operative -infection, nonunion, malunion, failed fixation.
- Clinical follow-up will be done at 2weeks, 4 weeks, 8 weeks, 4months, 6months, 12months intervals regarding healing of fracture, pain, and functional evaluation. Functional outcome of the patients were assessed by Modified Merle‘d Aubinge Postel score.

- Radiological follow up by X ray will be done at 2weeks, 4 weeks, 8 weeks, 4months, 6months, 12months intervals in accordance with symptoms and its assessment was done post operatively by Matta‘s criteria.

Inclusion criteria

1. Age group 18 to 70 years of either sexes.
2. Fractures duration less than 21 days after haemo dynamic stabilization.
3. Acetabular fracture-Confirmed by clinical examination, x rays and if required CT scan.
4. Patients who give informed consent and willing for follow up.

Exclusion criteria

1. Compound fractures of pelvis.
2. Patients less than 18 years of age.
3. Patients unfit for surgery.
4. Pregnancy.
5. Associated comorbid conditions history of suffering from Myocardial Infarction(MI) less than 1year, psychiatric illness, head injury.
6. Uncontrolled Diabetes mellitus (DM), Hypertension.
7. Pathological fracture.
8. Peri prosthetic fractures.
9. Associated major visceral injury.

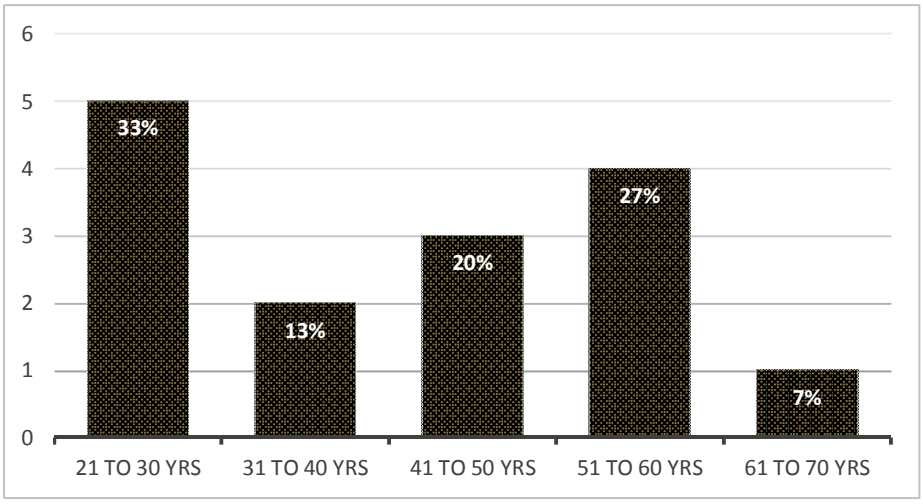
OBSERVATION AND RESULTS

Fifteen patients with acetabular fractures who were treated surgically were analysed for a follow up period of an average 10.5 months ranging from 4 months to 2 ½ years.

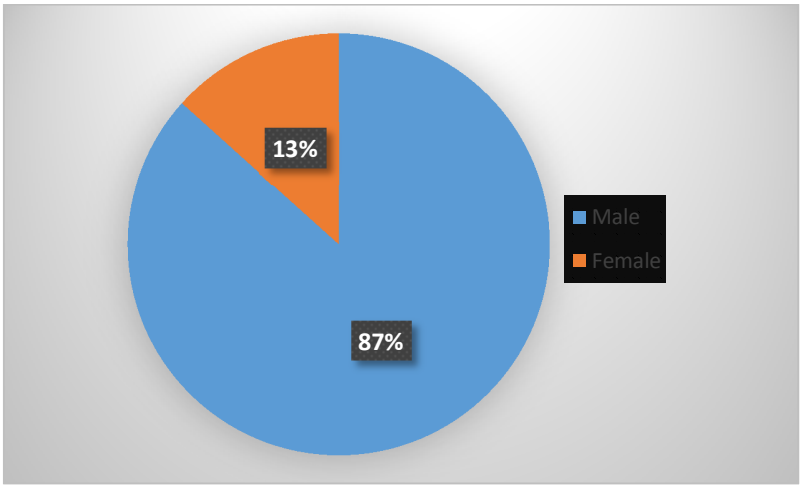
1. AGE INCIDENCE AND DISTRIBUTION:

In this study, the mean age of the patients was 41.27 years ranging from 22 to 63years. 66% of them belonged to less than 50 years among which 33% patients were in the 3th decade.

Age	n	%
21 to 30 Years	5	33
31 to 40 Years	2	13
41 to 50 Years	3	20
51 to 60 years	4	27
61 to 70 years	1	7



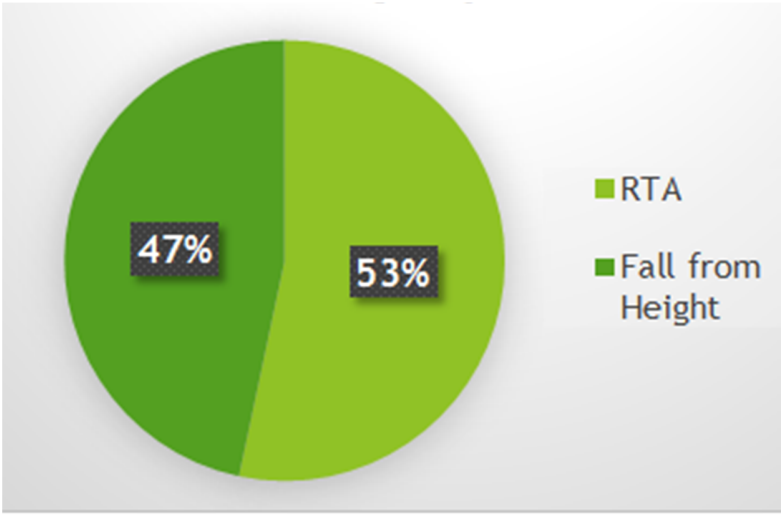
2. **SEX INCIDENCE:** Males predominated in our study with M:F ratio of 13:2.



3. MODE OF INJURY:

Fall from height contributed to a significant number of injury upto 47% in our patients, however the majority being Road Traffic Accidents 53%.

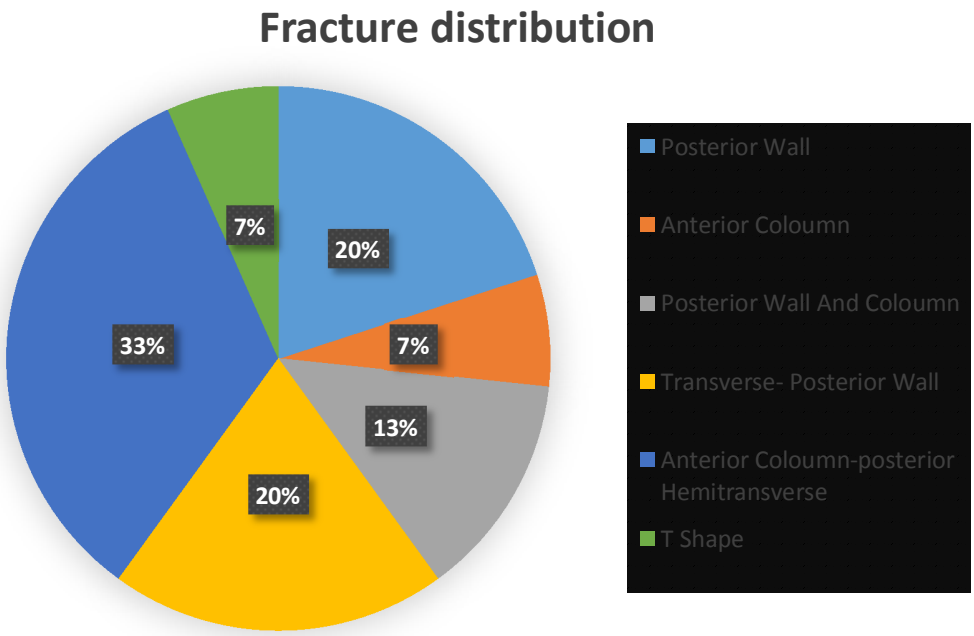
Mode of injury	n	%
RTA	8	53
Fall from Height	6	47



4. FRACTURE DISTRIBUTION:

In our study, Anterior column with posterior hemitransverse was the most common pattern(5 cases). Elementary fractures were seen only in 4 cases, among which posterior wall fractures predominated (3 cases).

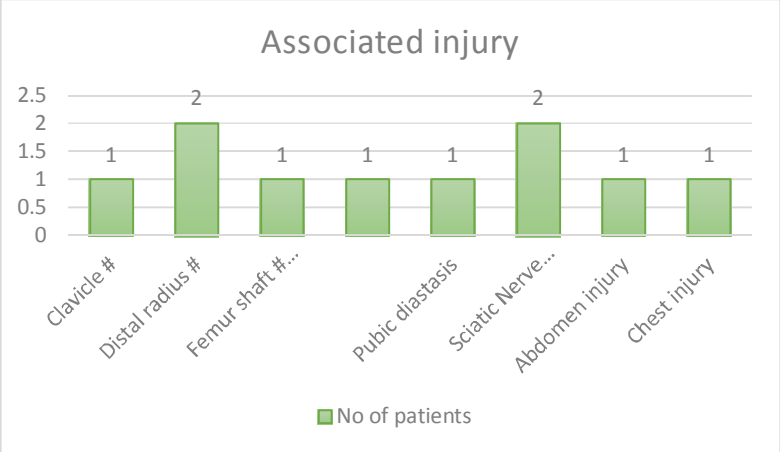
Fracture types	n	%
Posterior Wall	3	20
Anterior Coloumn	1	6
Posterior Wall And Coloumn	2	13
Transverse- Posterior Wall	3	20
Anterior Coloumn-posterior Hemitransverse	5	33
T Shape	1	7



5. ASSOCIATED INJURY:

Six patients had associated other bony injuries. Two patient had post traumatic sciatic nerve injury and one patient had associated chest & abdominal injury (splenic and liver injury).

Associated injury	n
Fracture of clavicle	1
Fracture of Distal radius	2
Fracture shaft of contralateral Femur	1
Bilateral shaft of femur fracture	1
Pubic diastasis	1
Sciatic Nerve palsy	2
Abdomen injury	1
Chest injury	1



In contrast to pelvic injuries, most of the patients were hemodynamically stable at the time of admission. One patient had pubic diastasis that was conservatively managed. No patient had sacroiliac disruption or other pelvic injuries.

6. SURGICAL APPROACHES:

Kocher langenbeck approach alone was used in majority of the patient(12 Patients). Two cases were operated in two sitting, first with a posterior Kocher Langenbeck's approach followed by anterior Modified Stoppa's approach.

Procedure	n
Kocher Langenbeck Approach alone	12
Modified Stoppa's and Ilioinguinal lateral window alone	1
Modified Stoppa's and Iliofemoral lateral window alone	1
Kocher Langenbeck Approach followed by anterior approach	2

The approach for each was decided based on

- Fracture side with major displacement dictated the first approach
- The necessity for another approach was decided by post operative radiological assessment of the first approach
- Intra operative fracture stability assessed under C-arm was also taken into account for other approach

7. In this study the average surgical time was 180 minutes spanning from 2 to 4 hours. Patients were operated on an average 12 days after the initial trauma, ranging from 2 to 21 days.

8. COMPLICATIONS:

Complications	n	Incidence
Infection	2	13%
Intra-articular screw	1	7%
Sciatic nerve palsy	1	7%
Avascular necrosis of hip	1	7%

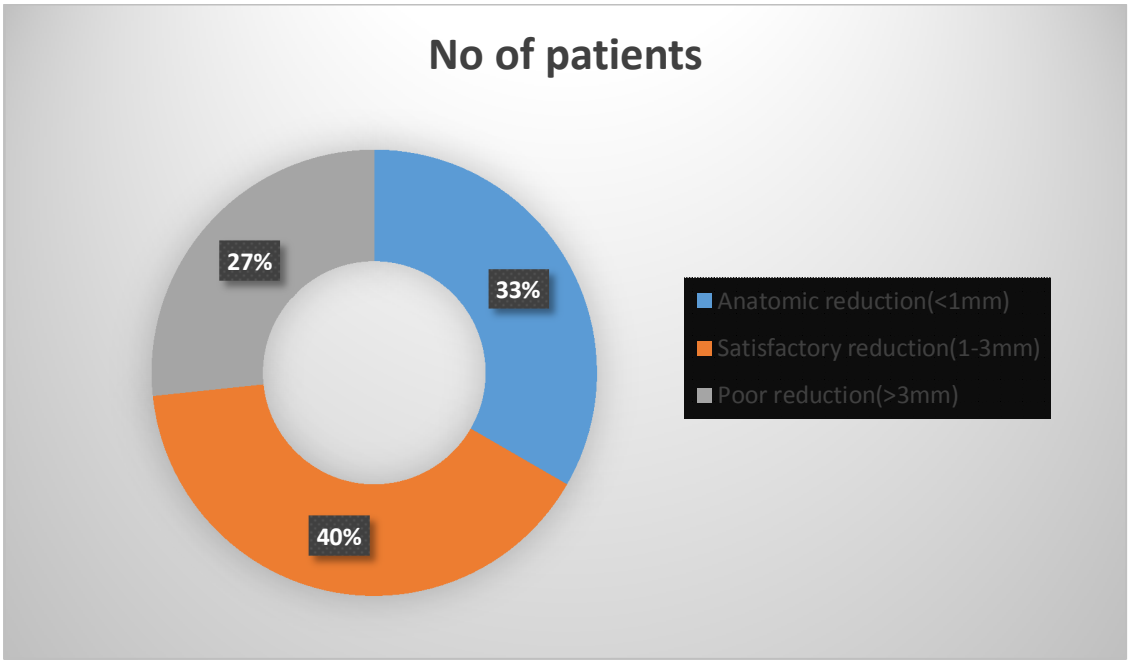
Four patients have encountered operative complications.

a) Two patient operated by Kocher Langenbeck approach had superficial infection which settled with antibiotics and wound wash.
b) One patient was found have intraaticular screw operated for posterior wall fracture alone.
c) One patient operated by the posterior Kocher langenbeck approach developed sciatic nerve palsy.
d) One patient had Avascular necrosis of femoral head during one year follow up.

9. RADIOLOGICAL OUTCOME:

According to Matta's criteria, Anatomic reduction was achieved in 5 patients, Satisfactory reduction in 6 patients and Poor reduction in 4 patients(>3mm gap).

Matta's criteria	n	%
Anatomic reduction(<1mm)	5	33
Satisfactory reduction(1-3mm)	6	40
Poor reduction(>3mm)	4	27



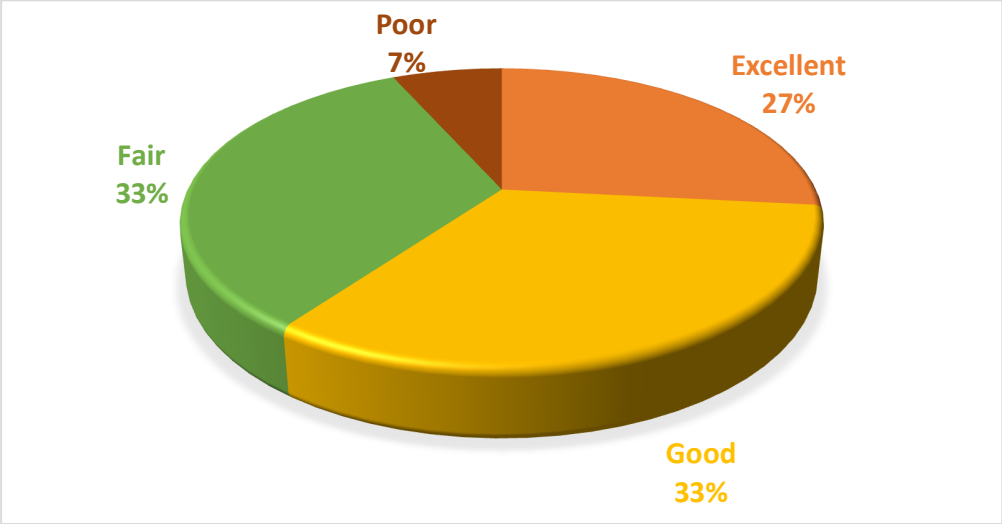
10. FUNCTIONAL OUTCOME:

Out of 15 patients, four patients had attained excellent functional status, five patient had good with five patient having fair and only 1 patient having a poor result. Function outcome score for patients ranged from 10 to 18 (Max Score- 18).

The average Merle d'Aubigne score in anatomically reduced fractures was 15.1, in imperfect reduction it was 15.8 and in poorly reduced fracture it was 14.5.

73% patient are having near normal life and 93% patient are having satisfactory result in our study.

Merle d'Aubigne score	n	%
Excellent	4	27
Good	5	33
Fair	5	33
Poor	1	7



The poor result (Score-10) in a patient was due to Avascular necrosis of femoral head. Patient had posterior coloumn and posterior wall fracture associated with central hip dislocation, operated 16 days post injury by posterior Kocher Langenbeck approach. Total hip arthroplasty was done for this patient at 11 months after surgery.

There were five patients with anterior coloumn posterior hemitransverse fracture cases, among whom all had excellent or good results except one patient who had fair functional outcome.

Associated posterior wall fracture had reduced the outcome score.

Fracture types	**n**	**Average score**	**Result**			
			Excellent	Good	Fair	Poor
Posterior Wall	3	16.5	1	1	1	-
Anterior Coloumn	1	16	1	-	-	-
Posterior Wall And Coloumn	2	14	1	1	-	-
Transverse- Posterior Wall	3	14.6	-	1	1	1
Anterior Coloumn- Posterior Hemitransverse	5	16.2	1	2	2	-
T Shape	1	14	-	-	1	-

CASE 1

Name: Mr Tamilvannan DOA: 06/11/2017

Age & Sex: 24yrs/M DOS: 15/11/2017

Occupation: Civil engineer DOD: 24/11/2017

Address: #258, Main road, Kottur malaiyandi pattanam, Pollachi

Diagnosis: Right Acetabulum fracture- Anterior column with Posterior Hemitransverse

Mode of Injury: Road traffic accident- while travelling in car (sitting behind driver) hit against a tree sidewards

Associated injury: Pubic Diastasis, Sacral ala fracture right side. Splenic injury grade 3, Liver injury grade 3 with mild haemoperitoneum. Mild right lower ribs fracture with lung contusion and bilateral haemothorax.

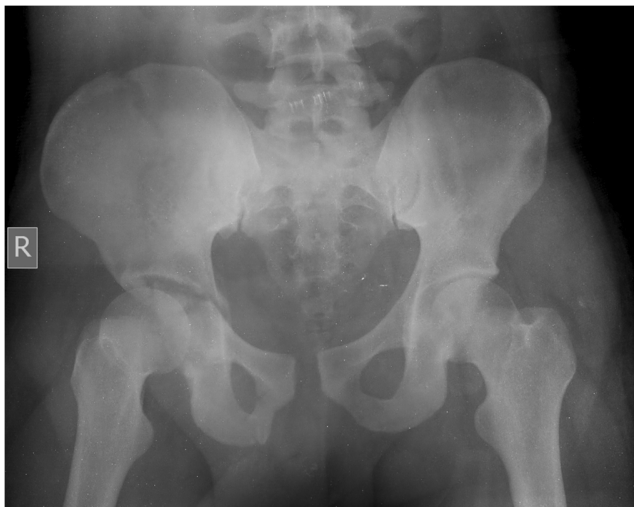
Procedure: ORIF with plate osteosynthesis through Kocher Langenbeck approach

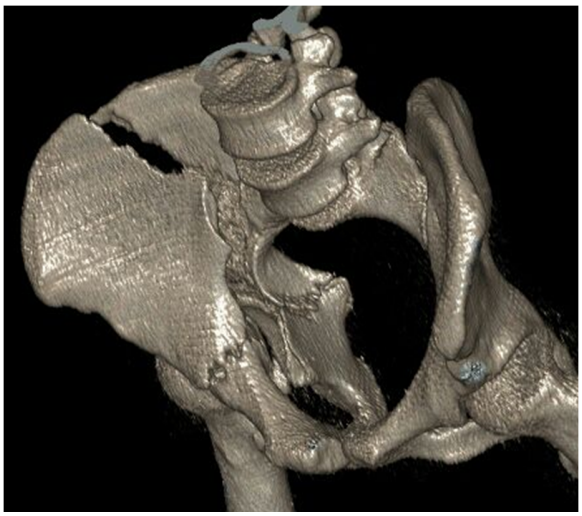
Outcome: 9months follow up-

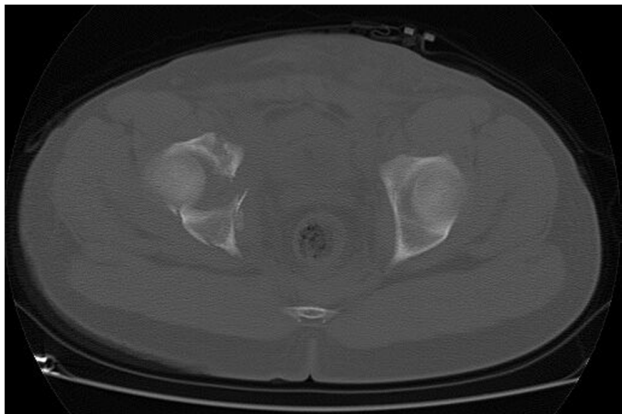
Clinical – Excellent (18/18 Merle d'Aubigne score)

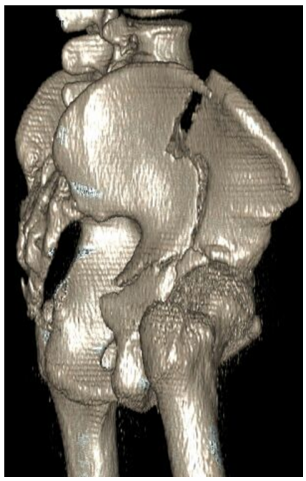
Radiological – Anatomic reduction (<1mm- Matta score)

PRE OPERATIVE RADIOLOGY

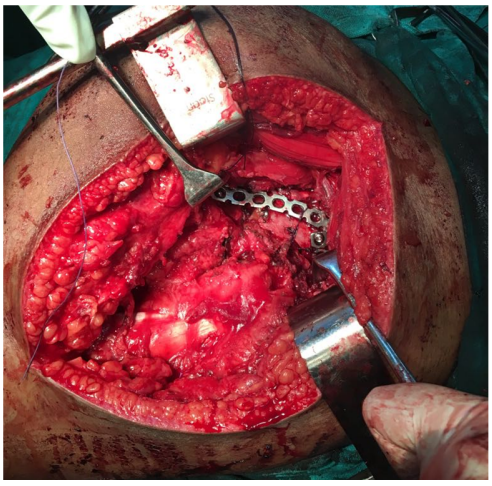








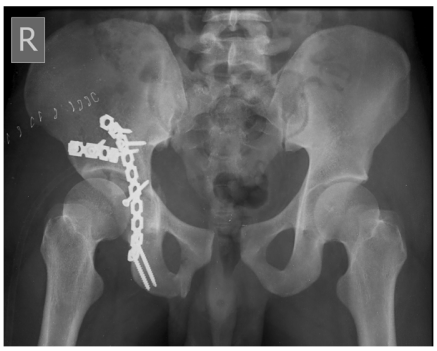
INTRAOPERATIVE



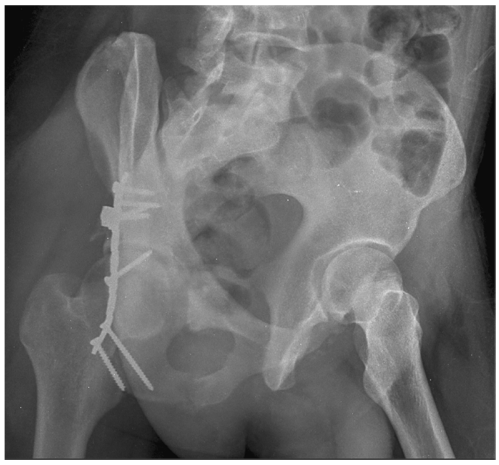
POST OPERATIVE

Immediate post opt

3 months follow up



9 months follow up



CASE 2

Name: Mr Kandhasamy DOA: 28/08/2016

Age & Sex: 63yrs/M DOS: 15/09/2016

Occupation: Coconut seller DOD: 04/10/2016

Address: #61, Kondhasamy street, Velandipalayam, Coimbatore.

Diagnosis: Left Acetabulum fracture- Anterior column with Posterior Hemitransverse

Mode of Injury: Accidental Fall from Height of 10 feet.

Associated injury: Nil

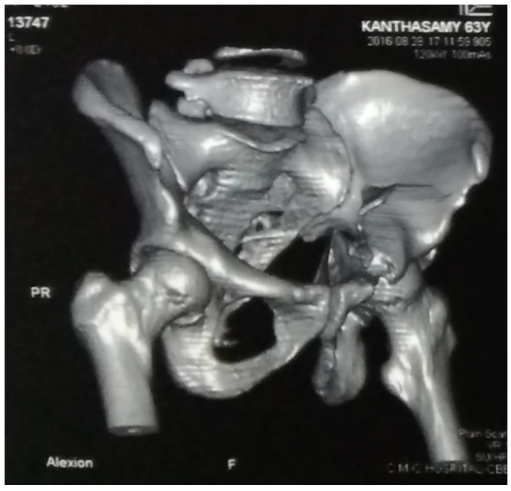
Procedure: ORIF with plate osteosynthesis through Kocher Langenbeck approach

Post operative: Inj Enoxaparin SC 3 days (DVT prophylaxis). Patient had a trivial fall during 1&1/2 yrs follow up and sustained a pathological fracture of proximal tibia at the upper tibial pin traction site. Patient recovered completely with conservative management.

Outcome: 2yrs follow up- Clinical – Good (15/18 Merle d'Aubigne score)

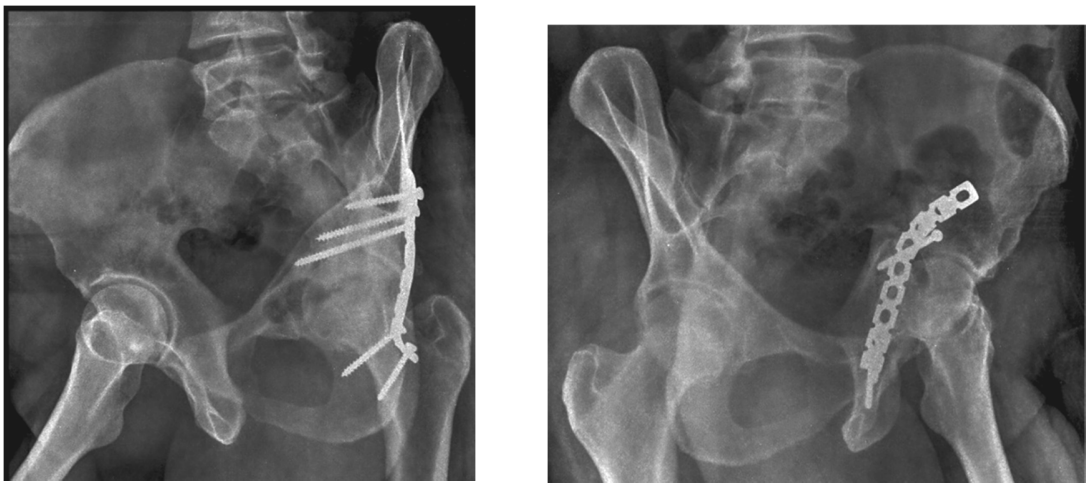
Radiological – Poor reduction (4mm- Matta score)

PRE OPERATIVE RADIOLOGY



POST OPERATIVE

Immediate post opt | 1 year follow up | 2 years follow up



CASE 3

Name: Mr Krishnan DOA: 20/04/2018

Age & Sex: 63yrs/M DOS: 28/04/2018 & 09/05/2018

Occupation: Vegetable vendor DOD: 25/05/2018

Address: No. 13 Raji Nagar, Pongalur, Paladam

Diagnosis: Left Acetabulum fracture- Anterior column with Posterior Hemitransverse with central hip dislocation

Mode of Injury: Road Traffic Accident- Bicycle rider against a 4 wheeler

Associated injury: Nil

Procedure: ORIF with plate osteosynthesis in 2 sitting-

1st Kocher Langenbeck approach

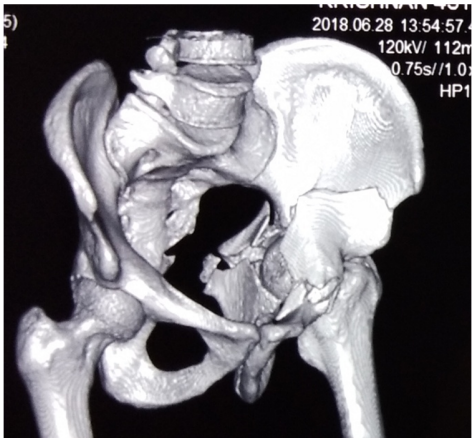
2nd Modified Stoppa's and Iliofemoral lateral window

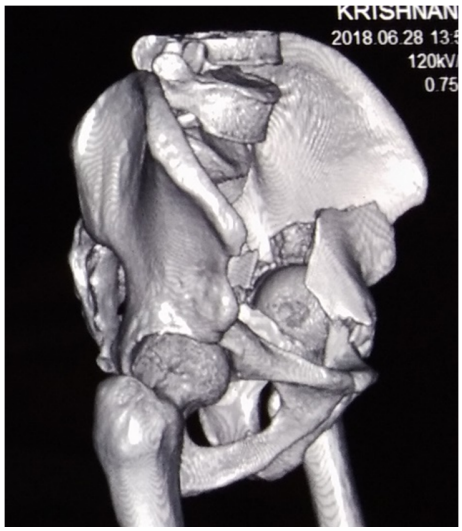
Post operative: Diagnosed with Mucinous adenoma from femoral lymph node biopsy sample analysis, on further evaluation.

Outcome: 2yrs follow up- Clinical – Excellent (18/18 Merle d'Aubigne score)

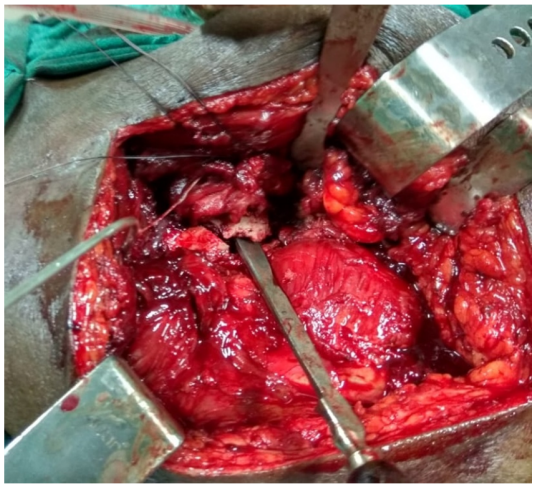
Radiological – Imperfect reduction (2mm- Matta score)

PRE OPERATIVE RADIOLOGY





INTRA OPERATIVE IMAGES



POST OPERATIVE

1ST Posterior plating

2nd Anterior plating

CASE 4

Name: Mr Suresh Ponnu DOA: 08/02/2018

Age & Sex: 29yrs/M DOS: 14/02/2018

Occupation: Cooli worker DOD: 20/02/2018

Address: #414, Kariyambala Palagad, Kerala

Diagnosis: Left Acetabulum fracture- Anterior column

Mode of Injury: Accidental fall from height of 8 feet

Associated injury: Nil

Procedure: ORIF with plate osteosynthesis via Modified Stoppa's and Ilioinguinal lateral window

Post operative: No complication

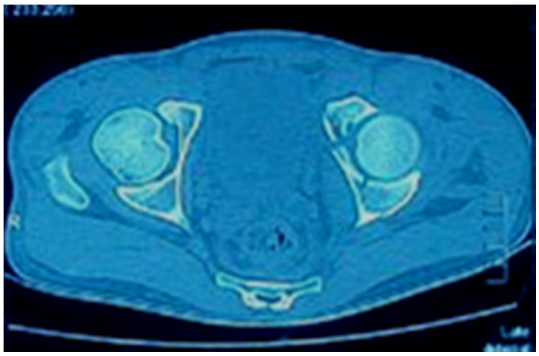
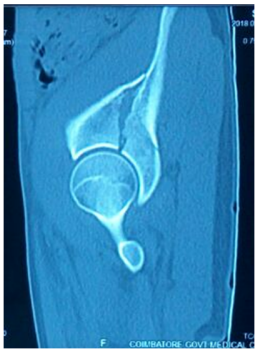
Outcome: 6months follow up-

Clinical – Excellent (18/18 Merle d'Aubigne score)

Radiological – Anatomic reduction (<1mm- Matta score)

PRE OPERATIVE



POST OPERATIVE


CASE 5

Name: Mr Manoj DOA: 26/07/2017

Age & Sex: 22yrs/M DOS: 01/08/2017

Occupation: Ice cream vendor DOD: 23/08/2017

Address: #492, Sundhu Palaya road, Kumarsamy Colony, Coimbatore- 02

Diagnosis: Left Acetabulum fracture- Posterior wall fracture with posterior hip dislocation left side

Mode of Injury: Road traffic accident- while driving a 2 wheeler hit against a stationary 4 wheeler (Dash Board Injury).

Associated injury: Nil

Procedure: Emergency closed manual reduction of left hip under IV sedation

ORIF with plate osteosynthesis through Kocher Langenbeck approach

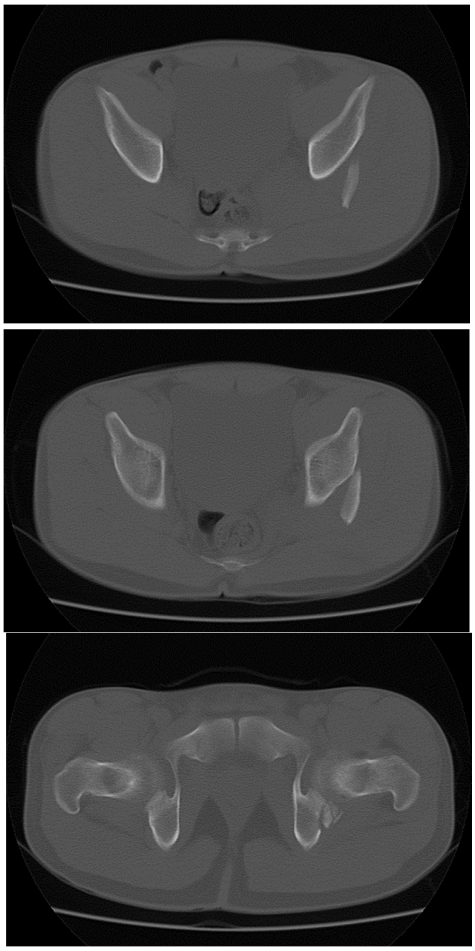
Complication: Intra articular screw placement- Restricted flexion movement at hip

Outcome: 1 year follow up-

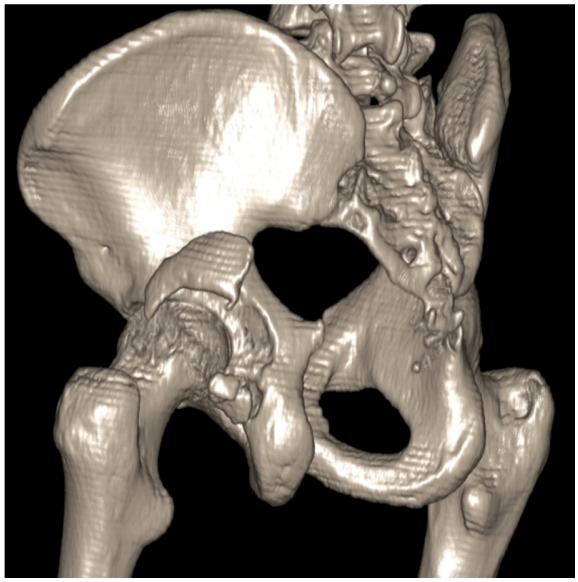
Clinical –Good (15/18 Merle d'Aubigne score)

Radiological – Anatomic reduction (<1mm- Matta score)

PRE OPERATIVE

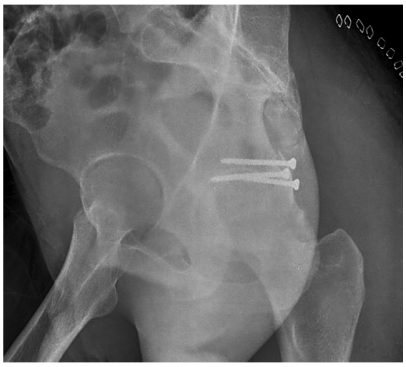


Fragment measuring 7 * 5 cms

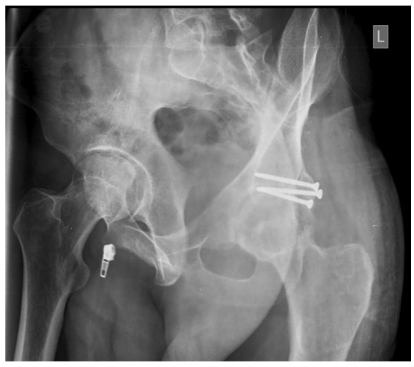


POST OPERATIVE

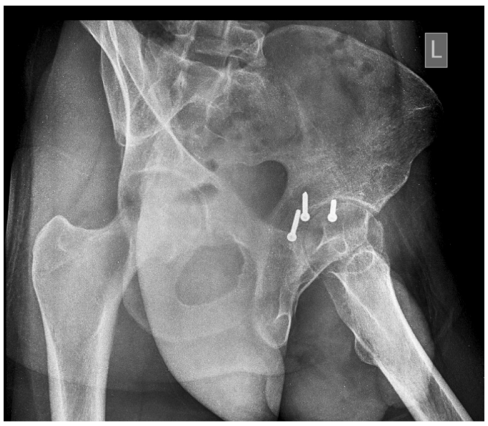
Immediate post opt



6 months follow up



1 year follow up



DISCUSSION

The options for acetabular fracture management are wide and are being continuously refined over time. Acetabular fracture is encountered mostly in young individuals and mainly due to road traffic accidents. Our study confirms the same.

The mean age group in our study was 41.27 years with Swiontkowski et al [12] having a similar mean age. Males predominated as in other studies.

Management of displaced fractures of the acetabulum requires adequate exposure with minimal morbidity. In our study posterior approach alone was sufficient in majority of the cases (12 patients) except in 2 patients where we use combined anterior and posterior approaches. According to Tile [1], even with the best hands, depending upon the type and complexity of these fractures, anatomic reduction can be achieved in only 70% cases of acetabular fractures. In this study, we were able to obtain satisfactory reduction in 73% patients and 93% of favorable result in short term.

The advocated non-extensile approaches had an average blood loss and operating time similar to those reported by other studies (Matta et al [9] 1986; Reinert et al 1988; Goulet and Bray 1988; Routt and Swiontkowski [12] 1990).

The highlight of open reduction and internal fixation is accurate anatomic reduction, rigid stable fixation and early mobilization which can keep the joint

functional as stated by Matta [9]. Pennal et al[13] documented that the quality of clinical outcome depends directly on the quality of the fracture reduction achieved during open reduction and internal fixation. In our study, there was a decreased mean functional score (14) in the fracture group with poor reduction compared to other groups(Anatomical Reduction 15.1,Imperfect reduction -15.8).

H. J. Kreder et al [14] enlisted various factors influencing the outcome like - degree of primary displacement, damage to the superior weight bearing roof or femoral head, amount of hip joint instability caused by posterior wall fracture, adequacy of closed or open reduction and late complications like chondrolysis, heterotrophic ossification, AVN or nerve injuries. In our current study, associated posterior wall fractures had reduced functional outcome.

Giannoudis et al [15] in their meta-analysis had reported 5.6 % of AVN incidence in posterior approaches. We had one case of avascular necrosis of femoral head (7%) producing poor outcome in our study. Patient came with AVN at 11 month following which a total hip arthroplasty was done. The stipulated reasons for AVN were unreduced dislocation for prolonged period (> 6 hours) and Intra operative posterior capsular vascular injury. These can be avoided by- Emergency reduction of dislocation with elective fracture stabilization and posterior capsular preservation helping in maintaining femoral head vascularity.

Extensile approaches around the hip joint have resulted in a high rate of complications. Alonso et al [16] reported the incidence of heterotopic ossification to be 53% with Triradiate approach and 86% with the use of extended iliofemoral approach. In non-extensile approaches, Kaempffe et al had reported a 20% incidence heterotopic ossification [17]. No case of heterotopic ossification had been encountered till now in our study as we used repeated intra operative wash with saline and Indomethacin prophylaxis post operatively for 6 weeks.

Giannoudis et al [15] reported 8% and Swiontkowski et al [12] also showed 8.3 % of iatrogenic sciatic nerve palsy in posterior approaches. Preoperative documentation of post-traumatic sciatic nerve palsy is essential. In our study we had 2 such cases which recovered post operatively. Also we had one case of iatrogenic sciatic nerve palsy in posterior approach (7%). Keeping knee joint in adequate flexion throughout posterior approach and avoiding placement of Hohmann retractor in greater sciatic notch ensured avoiding iatrogenic sciatic nerve palsy in rest of the cases.

One patient had intra articular screw penetration after fixation through posterior approach, and had restriction of flexion movement at hip. There was no pain and the functional outcome was very good. The complication rate is very low when compared to the earlier studies of Matta and Swiontkowski.

According to Marwin M Tile [1], Transverse has the best prognosis and anterior column with posterior hemitransverse, T Type fractures have worst prognosis. In contrast to it, in our study elementary/simple fractures and anterior column with posterior hemi transverse fractures showed better results. Posterior column with posterior wall fractures and T Type had reduced outcome.

Even though this current study comprised a small cohort of 15 patients, following a standard protocol of good pre-operative planning, use of only non-extensile approaches and early rehabilitation, we were able to achieve 93% satisfactory result as per modified Merle dAubigne and Postel scoring system [19]. However, further long term follow up is needed to comment on the final functional outcome.

CONCLUSION

Acetabular fractures, both simple and complex types, treated surgically by open reduction and internal fixation have a satisfactory functional outcome. Every chance of reducing the fracture fragments anatomically, fixing it rigidly and mobilizing early should be done for better functional outcome which is not achievable by conservative means.

CT evaluation with 3D reconstruction is a must, as it aids in fracture classification and preopertative planning. Bladder catherisation and enema on the day of surgery is facilitatory.

In operation theatre, patient must be positioned for C-arm accessibility and draping done to enable knee flexion. Sciatic nerve function more important than fracture stabilization. Special plate bender and pointed clamps are a must in the armamentarium.

Use of non-extensile approaches alone is sufficient to attain adequate fracture reduction with minimal possible complications.

Treatment of fractures of acetabulum is a challenging job for any orthopaedic surgeon. With a definitive learning curve, proper pre-operative planning, use of non-extensile exposure, accurate anatomic reduction, rigid fixation and early rehabilitation, it is possible to achieve an improved outcome.

LIMITATIONS

Smaller sample size of the study.

Longer follow up and a multi-centric study is required for assessing the functional outcome especially regarding the incidence of avascular complications, Osteoarthritis and other complications.

BIBLIOGRAPHY

1. Tile M. Fractures of the pelvis and acetabulum. 2nd ed. Baltimore: Williams and Wilkins; 1996.
2. Judet R, Judet J, Letournel E. Fractures of the acetabulum: classification and surgical approaches for open reduction. preliminary report. J Bone Joint Surg Am. 1964;46:1615-46.
3. James L. Guyton Edward A. Perez , Fractures of acetabulum and pelvis . In Canale & Beaty: Campbell's Operative Orthopaedics, Mosby elsivier 11th ed.2007-3306.
4. Levine, R., Renard, R., Behrens, F., Tornetta, P.: Biomechanical consequences of secondary congruence after bothcolumn acetabular fracture. J. Orthop. Trauma, 16: 87–91, 2002
5. Thompson VP, Epstein HC. Traumatic dislocation of the hip. A survey of two hundred and four cases covering a period of twenty-one years. J Bone Joint Surg Am. 1951; 33:746–777.
6. Knight RA, Smith H. Central fractures of the acetabulum. J Bone Joint Surg Am. 1958;40-A:1–16.
7. Rowe, Carter R.; Lowell, J. Drennan Prognosis of Fractures of the Acetabulum. JBJS: January 1961 - Volume 43 - Issue 1 - p 30-92
8. Letournel E, Judet R. Fractures of the acetabulum. Second ed. Berlin: Springer-Verlag, 1993

9. Matta JM. Fractures of the acetabulum: accuracy of reduction and clinical results in patients managed operatively within three weeks after the injury. J Bone Joint Surg [Am] 1996;78-A:1632- 45.
10. Joel m. matta, m.d.t, los angeles, california, Fractures of the Acetabulum: Accuracy of Reduction and Clinical Results in Patients managed Operatively within Three weeks after the Injury, Journal of Bone and Joint Surgery1996;78:1632-45.
11. Stoppa RE. The treatment of complicated groin and incisional hernias. World J Surg. 1989;13(5):545–554. doi: 10.1007/BF01658869.
12. M.L chip routt, marc .F. Swiontkowski, seattle , Washington Operative treatment of complex acetabular fracture . JBoneJointSurg(Br]1990 VOL. 72-A, NO. 6, 897
13. Pennal GF, Davidson J, Garside H, et al. Results of treatment of acetabular fractures. C/in Orthop 1980; 151 :11S-23.
14. H. J. Kreder,N. Rozen,C. M. Borkhoff,Y. G. Laflamme,M. D. McKee,E. H. Schemitsch,D. J. G. Stephen Determinants of functional outcome after simple and complex acetabular fractures involving the posterior wall, J Bone Joint Surg [Br] 2006;88-B:776-82.
15. P. V. Giannoudis, M. R. W. Grotz, C. Papakostidis, H. Dinopoulos Operative treatment of displaced fractures of the acetabulum a

meta-analysis J Bone Joint Surg Br January 2005 vol. 87-B no. 1 2-9

16. Alonso JE, Davila R, Bradley E: Extended iliofemoral versus triradiate approaches management of associated acetabular fractures. Clin Orthop 305:81-87, 1994
17. Kaempffe, F. A.; Bone, L. B.; and |and |Border, J. R.: Open reduction and internal fixation of acetabular fractures: heterotopic ossification and other complications of treatment. J. Orthop. Trauma, 5: 439-445, 1991
18. K. David Moore, Katy Goss, Jeffrey O. Anglen Indomethacin versus radiation therapy for prophylaxis against heterotopic ossification in acetabular fractures British Editorial Society of Bone and Joint Surgery march 1998 vol. 80-b, no. 2.
19. Merle d'Aubigne, R. M., and Postel, M.: Functional results of hip arthroplasty with acrylic prosthesis. J. Bone and Joint Surg., 36-A: 451-475, June 1954.
20. Henry AK: Extensile Exposure. 3rd ed. Edinburgh: Churchill Livingstone;1972.
21. Christopher c. schmidt, gary s. gruen , Non-extensile surgical approaches for two column acetabular fractures JBoneJointSurg(Br] 1993; 75-B:556-61.

22. Laird A, Keating JF. Acetabular fractures: a 16-year prospective epidemiological study. J Bone Joint Surg Br. 2005;87:969–973. doi: 10.1302/0301-620X.87B7.16017.
23. Rk sen , O N nagi Anterior fractures of acetabulum, IJO vol 36, jan 2002.
24. Pearson JR, Hargadon EJ. Fractures of the pelvis involving the floor of the acetabulum. J Bone Joint Surg Br. 1962;44-B:550–561.
25. Cj Thakkar Complex fractures of acetabulum, IJO vol 36, jan 2002 8.
26. Ferguson TA, Patel R, Bhandari M, Matta JM. Fractures of the acetabulum in patients aged 60 years and older: An Epidemiological and Radiological Study. Bone Joint Surgery Br. 2010 Feb;92(2):250–257.
27. Matta JM. Operative treatment of acetabular fractures through the ilioinguinal approach: a 10-year perspective. J. Bone Join Surgery Am. 2009 Jun;129(6):719–727.
28. Borrelli J, Jr, Goldfarb C, Ricci W, Wagner JM, Engsberg JR. Functional outcome after isolated acetabular fractures. J Orthop Trauma. 2002;16(2):73–81.
29. Berton R. Moed, Paul H. Yu and Konra I. Gruson Functional Outcomes of Acetabular Fractures , ,J Bone Joint Surg Am. 2003;85:1879-1883

ANNEXURE – I

ஒப்புதல் படிவம்

பெயர் :

பாலினம் :

வயது :

முகவரி :

அரசு கோவை மருத்துவக் கல்லூரியில் எலும்பு முறிவு மருத்துவ துறையில் பட்ட பயிலும் மாணவன் அவர்கள் மேற்கொள்ளும் titled ***"FUNCTIONAL AND RADIOLOGICAL OUTCOME OF SURGICAL MANAGEMENT OF ACETABULAR FRACTURES "*** குறித்த ஆய்வில் செய்முறை மற்றும் அனைத்து விவரங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுப்படுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடன், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் என்னுடைய அனைத்து விபரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்திலும் இந்த ஆய்விலிருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

ANNEXURE – II

PATIENT EVALUATION PROFORMA

Patient details

Patient Name :	**Age :**	**Sex : M/ F / TG**
Occupation :	**IP NO :**	
Address :	**Contact no :**	
Unit :	**Professor :**	
DOA :	**DOS :**	**DOD :**
Clinical History :		
Presenting Complaints :		
Mode of Injury :		

Clinical Evaluation

Pre injury status	
Ambulation :	**CVS :**
Obesity :	**RS :**
Diabetes :	**CNS :**
Hypertension :	**Psychiatric illness :**
Previous hip surgery:	

Back ground Data

Smoker :
Alcoholic :
Drug intake :

Associated injuries

Head Injury :

Chest Injury :

Other fractures :
If Any ,

Local Examination

Hip region :

Open / Closed :

Deformity :

Skin Condition :

Dental Condition :

ENT Condition :

Radiological Evaluation

X – ray Pelvis With Both hips AP :

X- Ray Affected Hip In Illiac oblique and Obturator oblique view :

X ray Chest :

Echocardiography :

CT Pelvis:

CLASSIFICATION :
Fracture Pattern : Letournel and Judet type- ……. Side.

Diagnosis :
Plan :

OPERATIVE DETAILS

Date of Surgery from injury :

Anaesthesia : GA / SA / Epidural **Fitness Under ASA : I / II / III / IV**

Operative Technique

Approach : Kocher Langenbeck's Posterior / Ilioinguinal / Extended Iliofemoral /Modified Stoppa's

Position :

TYPE :

Duration of Surgery : **Amount of Blood loss :**

Per operative findings and remarks :

Post operative :

Units of blood transfused : **SICU stay : Yes / NO**

Duration of I.V Antibiotics :

Thrombo – Prophylaxis :

Indomethacin Prophylaxis :

Post-operative Evaluation

Fever : **Pain : Visual analogue score , ……. / 10**

Wound discharge : **Swab for C & S in case of infection :**

Neuro vascular injury :

Shortening and other deformity :

Heterotrophic Calcification:

Radiological Evaluation :

At the time of discharge

Merle d'Aubigne Score : / 12	**Visual Analogue scale : / 10**
Wound healing :	
Range of movements:	
Duration of hospital stay :	
Complications :	

Follow up details

Follow up date	4th Week	2nd Month	4th Month	6th Month	1 Year	2 Year
Clinical status						
Radiological evaluation						
Merle d'Aubigne score						
Visual analogue scale						
Advice and Remarks						
Professor/Guide signature						

ANNEXURE – III

MASTER CHART

Sl. No	Name	Age/Sex	Mode of Injury	Diagnosis	Associated injuries	Date of Surgery	Time delay in days	Procedure	Surgical time	Complications	Follow up	Outcome (Total= 18) Result	Radiologic outcome
1	Paramasivam	55/M	Fall from height	Anterior Coloumn Posterior hemitransverse	-	22-07-17	17	ORIF via Kocher Langenback approach	2&1/2 hrs	-	1 yr	16 Good	Imperfect reduction (2mm)
2	Manoj	22/M	RTA	Posterior wall	Posterior hip dislocation	01-08-17	06	ORIF via Kocher Langenback approach	3 hrs	Restricted Flexion	1 yr	15 Good	Anatomic reduction
3	Kandhasamy	63/M	Fall from height	Anterior Coloumn Posterior hemitransverse	-	15-09-16	18	ORIF via Kocher Langenback approach	4 hrs	Pathological fracture of proximal tibia at UTPT pin site	2 yr	15 Good	Poor reduction (4mm)
4	Sunil Kumar	24/M	Fall From Height	Posterior Column & Posterior Wall	Communited Distal Radius Fracture	11-03-17	5	ORIF via Kocher Langenback approach	2 hrs	-	1& 1/2 yrs	18 Excellent	Anatomic reduction
5	Krishnan	45/M	RTA	Anterior Coloumn and Posterior Hemitransverse with central hip dislocation	-	28-06-18	8 & 19	ORIF via Kocher Langenback approach & modified stoppas with lateral window ilioinguinal	3 & 4 hrs	Mucinous adenoma	2 months	16 Good	Imperfect reduction (2mm)
6	Kannan	45/M	RTA	Posterior Coloumn and Posterior Wall with Central Hip Dislocation	Sciatic nerve injury	30/11/2016	16	ORIF via Kocher Langenback approach	4 hrs	-	2 yrs	15 to 10 poor	Imperfect reduction (2mm)
7	Pappathi	60/F	Fall from height	T shape fracture with medialisation of inferior segment with head	-	3/5/18 & 7/5/18	9 & 13	ORIF via Kocher Langenback approach & modified stoppas with lateral window ilioinguinal	3&1/2 and 4 hrs	Wound infection at posterior proximal operative site	3 months	14 fair	Imperfect reduction (2mm)

Sl No	Name	Age/Sex	Mode of Injury	Diagnosis	Associated injuries	Date of Surgery	Time delay in days	Procedure	Surgical time	Complications	Follow up	Outcome (Total= 18) Result	Radiologic outcome
8	Suresh Ponnu	29/M	Fall from height	Anterior column	-	14/2/18	7	ORIF via modified stoppas with lateral window ilioinguinal	3 hrs	-	6months	18 Excellent	Anatomic reduction
9	Tamilvannan	24/M	RTA	Anterior Coloumn Posterior hemitransverse	Liver & Spleenic injury, Chest injury, Pubic diastasis, Abrasion	15-11-17	9	ORIF via Kocher Langenback approach	3 hrs	Wound Infection (treated with antibiotics)	10 months	18 Excellent	Anatomic reduction
10	Paramanathan	59/M	Fall from height	Anterior column with posterior hemi-transverse right side	-	9-8-18	9	ORIF via modified stoppas with lateral window ilioinguinal	4 hrs	-	10 days	14 fair	Anatomic reduction
11	Thireselvam	51/M	RTA	Transverse with posterior wall	-	22-06-18	20	ORIF via Kocher Langenback approach (lateral position)	2 & ½ hrs	-	2 months	14 Fair	Imperfect reduction (2mm)
12	Kannan	42/M	Fall from height	Posterior wall	Posterior hip dislocation, Clavicle fracture	31-07-17	19	ORIF via Kocher Langenback approach (lateral position)	3& ½ hrs	Foot drop	1 yr	14 fair	Imperfect reduction (2mm)
13	Dhanalakshmi	34/F	RTA	Transverse + posterior wall with medialisation of inferior segment with head	Shaft of femur fracture opposite side	2-5-16	21	ORIF via Kocher Langenback approach	3 hrs	-	2 yrs	16 good	Poor (3 mm)
14	Raman	40/M	RTA	Posterior wall with anterior hip dislocation	B/L Shaft of femur #, Volar barton #, foot drop	22-11-16	2	ORIF via Kocher Langenback approach	4&½ hrs	-	2yrs	18 Excellent	Poor (3 mm)
15	Dhanapal Ramasamy	26/M	RTA	Transverse + posterior wall	Posterior hip dislocation	12-05-17	9	ORIF via Kocher Langenback approach	3 hrs	-	1& ½ yr	15 good	Imperfect reduction (2mm)